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FINAL
FOCUSED REMEDIAL INVESTIGATION/FEASIBILITY STUDY, OPERABLE UNIT 4, FORMER MARCH AIR FORCE BASE/AIR RESERVE BASE, CALIFORNIA

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TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

Page

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

ACM	asbestos-containing material
AFB	Air Force Base
AFRC	Air Force Reserve Command
AFRPA	Air Force Real Property Agency
AMR	American Metal Recycler
AOC	area of concern
ARB	Air Reserve Base
ASTM	American Society for Testing and Materials
bgs	below ground surface
BLM	Bureau of Land Management
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chain-of-custody (delete if only used once)
COPC	chemical of potential concern
DEHS	Department of Environmental Health Services
DOD	Department of Defense
DTSC	Department of Toxic Substances Control (California)
EBS	environmental baseline survey
EE/CA	engineering evaluation/cost analysis
EPA	Environmental Protection Agency
EPC	exposure point concentration
ESI	expanded source investigation
FFA	Federal Facility Agreement
FS	feasibility study
HI	hazard index
ICP	individually coupled plasma
IRP	Installation Restoration Program
I-TEF	international toxicity equivalency factor
MCL	maximum contaminant level
MDL	method detection limit
MEK	methyl ethyl ketone
μ/L	micrograms per liter
μg/kg	micrograms per kilogram
$\mu g/m^3$	micrograms per cubic meter
MJPA	March Joint Powers Authority
MSL	mean sea level
NCO	non-commissioned officers
NFA	no further action
NFADD	no further action decision document
ng/kg	nanogram per kilogram
NIOSH	National Institute of Occupational Safety and Health
NPL	National Priorities List
OEHNA	Office of Environmental Health Hazard Assessment
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PHG	public health goal
PPE	personal protective equipment
ppm	parts per million
PRE	preliminary risk evaluation

PRG	USEPA Region IX Preliminary Remediation Goal
PRL	potential release location
QA/QC	quality assurance/quality control
RCFCWCD	Riverside County Flood Control and Water Conservation District
RCRA	Resource Conservation and Recovery Act
RFA	RCRA facility assessment
RfD	reference dose
RI	remedial investigation
RL	reporting limit
RME	reasonable maximum exposure
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SKR	Stephen's kangaroo rat
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCDD	tetradichlorobenzo-p-dioxin
TCE	trichloroethylene
TCLP	Toxicity Characteristic Leachate Procedure
TDS	total dissolved solids
TEF	toxic equivalency factor
TOC	top of casing
TPH	total petroleum hydrocarbon
TRPH	total recoverable petroleum hydrocarbons
UCL	upper confidence limit
UF	uncertainty factor
USACE	US Army Corps of Engineers
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
UST	underground storage tank
UTL	upper tolerance limit
VOC	volatile organic compound
XRF	X-ray florescence

1.0 INTRODUCTION

This chapter describes the purpose and scope of the Operable Unit 4 (OU4) Focused Remedial Investigation (RI). Sites included in the OU4 RI include: Installation Restoration Program (IRP) Sites 21, 41, and 44; and non-IRP sites Site L, Water Tower 3410, Water Tank 6601, and the former Base Hospital and Dental Clinic. The chapter also includes all pertinent background information for March Air Force Base (AFB)/Air Reserve Base (ARB) to support this investigation

Of the sites evaluated in this RI, only Site L had residual contamination above residential PRGs. Site L was evaluated in detail by Tetra Tech, Inc. in an EE/CA (Tetra Tech, 1996). Therefore, screening of potential remedial actions was not necessary, and a Focused FS was not conducted. A summary of the EE/CA analysis for Site L is included in Section 3.

1.1 PURPOSE OF REPORT

The objectives of the OU4 RI were to define the vertical and lateral extent of environmental contamination at sites that were either not included or inadequately addressed in the OU1 and OU2 RI/FS and Record of Decision (ROD) documents. A synopsis of the OU4 sites and activities performed under this project are included in Table 1-1.

Table 1-1. OU4 Sites and Activities

Site	IRP Site	Investigation	Removal Action	Risk Evaluation
Site 21	Yes	Soil & groundwater	No	Yes
Site 41	Yes	Soil & groundwater	Soil excavation	No
Site 44	Yes	Soil	Soil excavation	No
Site L	No	Soil & groundwater	Soil excavation	No
Water Tower 3410	No	Soil	No	Yes
Water Tank 6601	No	Soil	Soil excavation	Yes
Former Base Hospital and Dental Clinic	No	Soil	No	Yes

IRP = Installation Restoration Program
OU4 = operable unit 4

1.1.1 OU4 RI Tasks

This section describes the scope of work for the March AFB/ARB OU4 RI, including field investigation activities and other project tasks. The project tasks described include:

- Field investigation tasks at OU4 sites outlined above

- Evaluation tasks, including record keeping and data assessment to record, validate, and analyze data

- Risk evaluation tasks addressing contaminant fate and transport at selected sites and developing risk estimates for contaminants of concern at each site included herein

1.1.2 Field Investigation

This section describes the field tasks, sampling, and analysis activities conducted in support of the RI.

Summary of Field Tasks. The Scope of Work for the RI field investigation included the following work tasks:

- Borehole drilling using air-rotary casing hammer and hollow-stem auger drilling techniques

- Collection of borehole soil samples via continuous cores and split spoons, for lithologic logging purposes

- Collection of discrete groundwater samples from boreholes

- Shallow boring completion

- Surface soil sampling.

Recordkeeping. Project documentation procedures were designed to ensure that the quality and integrity of the data collected and generated during the RI were maintained. Two main types of information associated with the study included:

- Information used to manage, monitor, and document project performance (i.e., Work Plan and Quality Program Plan, and quality assurance/quality control [QA/QC])

- Technical data required for or generated by a specific task or activity (i.e., field logbooks, borehole logs, sampling and water level data sheets, chain-of-custody (COC) forms, laboratory data and logbooks, calculation sheets, and borehole location maps).

Technical data were maintained in project logs and were updated as information was generated.

1.1.3 Data Assessment

The data collected or compiled during the RI includes field data and analytical laboratory data. Data that were assessed included:

- Regional and localized geologic, hydrogeologic, lithologic, and soil data

- Screening level groundwater data

- Groundwater level measurements (elevation and depth below ground surface [bgs])

- Hydrostratigraphy

- Analytical laboratory data.

Geologic, hydrologic, and sample location maps were developed. Where possible, data collected during the investigation was combined with existing data from previous or other ongoing studies to fully characterize the sites.

The data assessment work effort included evaluation and screening of field and laboratory data for acceptable accuracy and precision. All data was systematically reduced and tabulated to facilitate data review. Data reduction included computer analysis, graphic representation, or other methods that facilitated analysis of data and conceptualization of results. Data validation was performed on definitive-level sample analytical results.

1.1.4 Evaluation of Current Risk

Site-specific risk assessments have been completed for all IRP sites at March AFB/ARB during the OU-specific RI/FSs. During the OU4 RI, site-specific risk estimates were completed for sites which were either not addressed in the OU-specific RI reports or were not adequately addressed in the other OU-specific RI reports because of limited data (e.g., IRP Site 21)

Available site information on waste quantities and sources, potential transport and exposure pathways, and potential receptors at March AFB/ARB were used to calculate risk. Estimating the health and environmental risks associated with exposure to chemicals involved the following steps:

- Selecting chemicals of potential concern
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Uncertainty analysis
- Environmental risk assessment

Sections 3.5.1 through 3.5.5 of the RI/FS Final Work Plan Addendum for OU1 (Earth Tech, 1992) present a step-wise approach to estimate human health risk associated with exposure to chemicals from selected sites investigated during this RI. This approach to the risk assessment was applied in the same manner as during the OU1 risk assessment for IRP Site 21 (see Section 3 4 of the RI/FS Report for OU1) (The Earth Technology Corporation, 1994).

Preliminary risk evaluations were determined by comparing analytical results to U S. EPA Region IX preliminary remediation goal (PRG) values established in October 2002. If residual contamination was below the residential PRG for a particular contaminant, then a detailed risk assessment was not performed For inorganic compounds, site values were compared to both residential PRGs and background values that had been previously established in the OU1 and OU2 RI investigations. If inorganic contaminants exceeded background values and established residential PRGs, a detailed risk assessment was performed. If inorganic values exceeded residential PRGs but did not exceed background, the analyte was considered to be naturally occurring and was not evaluated further.

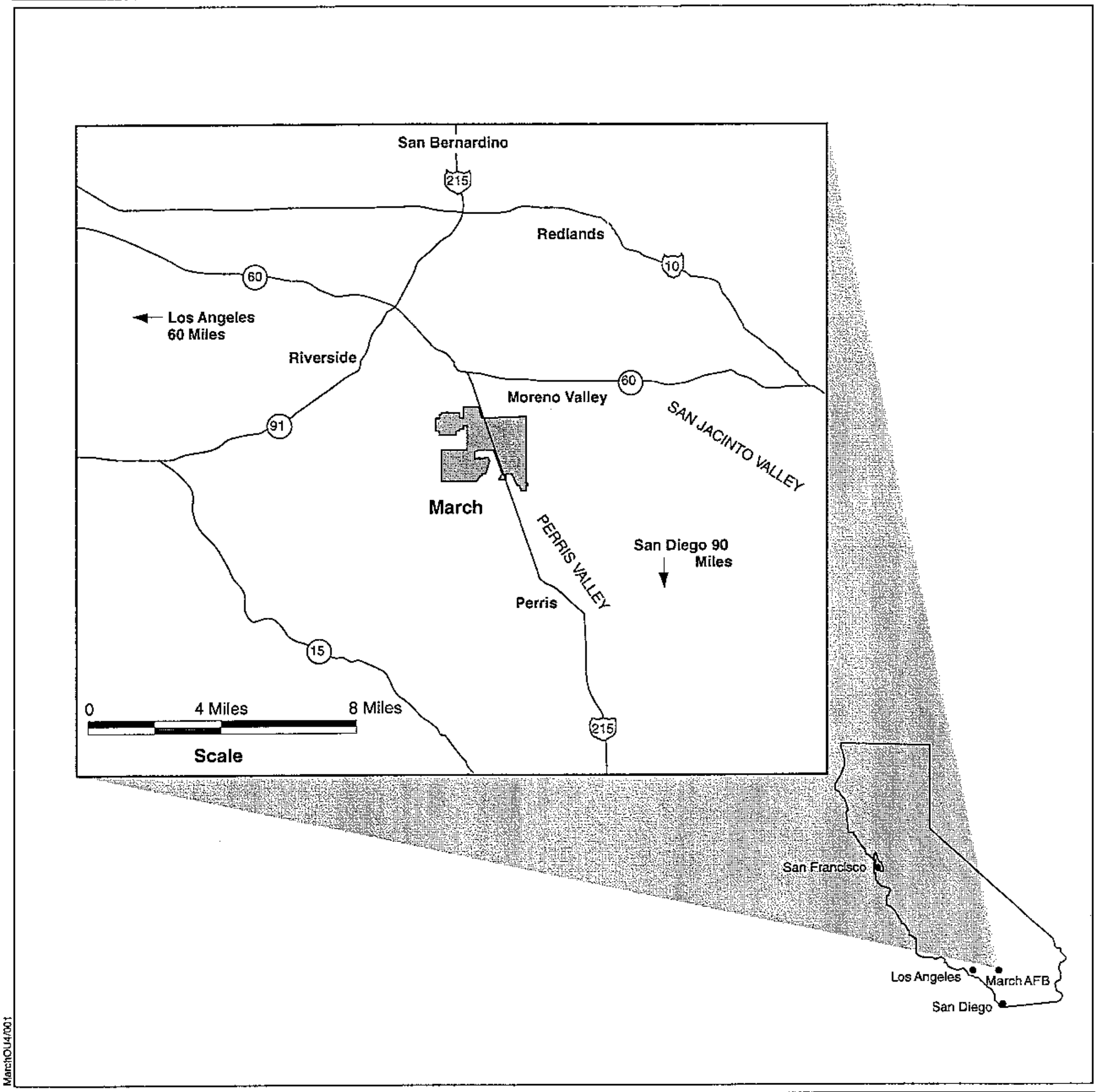
1.2 MARCH ARB BACKGROUND

March AFB/ARB is located east of Riverside, California (Figure 1-1), and was officially opened on 1 March 1918. Originally a 640-acre facility called the Alessandro Aviation Field, the base was initially used to train "Jenny" pilots during World War I. Following World War I, the base closed for about 4 years, then reopened in 1927 as March AFB By 1938, March AFB was considered to be the primary location for bombing and gunnery training on the west coast of the United States Camp Haan Army Base was constructed west of Interstate (I)-215 and extended approximately 5 miles south of Alessandro Boulevard. Camp Haan officially opened on 11 November 1940. Camp Haan was primarily used as an anti-aircraft artillery camp and as a staging area for General Patton's tank force (Tetra Tech, 1997b). Camp Haan became a part of West March after World War II. In 1949, the Strategic Air Command took control of March AFB, and by the 1950s, the base was primarily used as a bomber facility.

The beginning of the 1950s marked another change in the role of March AFB. Maintenance hangars were constructed for the 22nd Bombardment Wing's B-47 aircraft. Then, in the 1960s, additional support facilities were constructed to accommodate the increased number of military units and aircraft. These facilities included a wing maintenance control facility, an engine inspection and repair shop, a large maintenance dock, new officer quarters, and a dormitory (Tetra Tech, 1997b).

In the 1960s, 1970s, and 1980s new operations were brought to March, including bombardment and air refueling units Then in June 1992, March AFB became an Air Mobility Command installation. Its primary mission was air refueling; however, reserve and guard units had cargo and fighter missions based there as well.

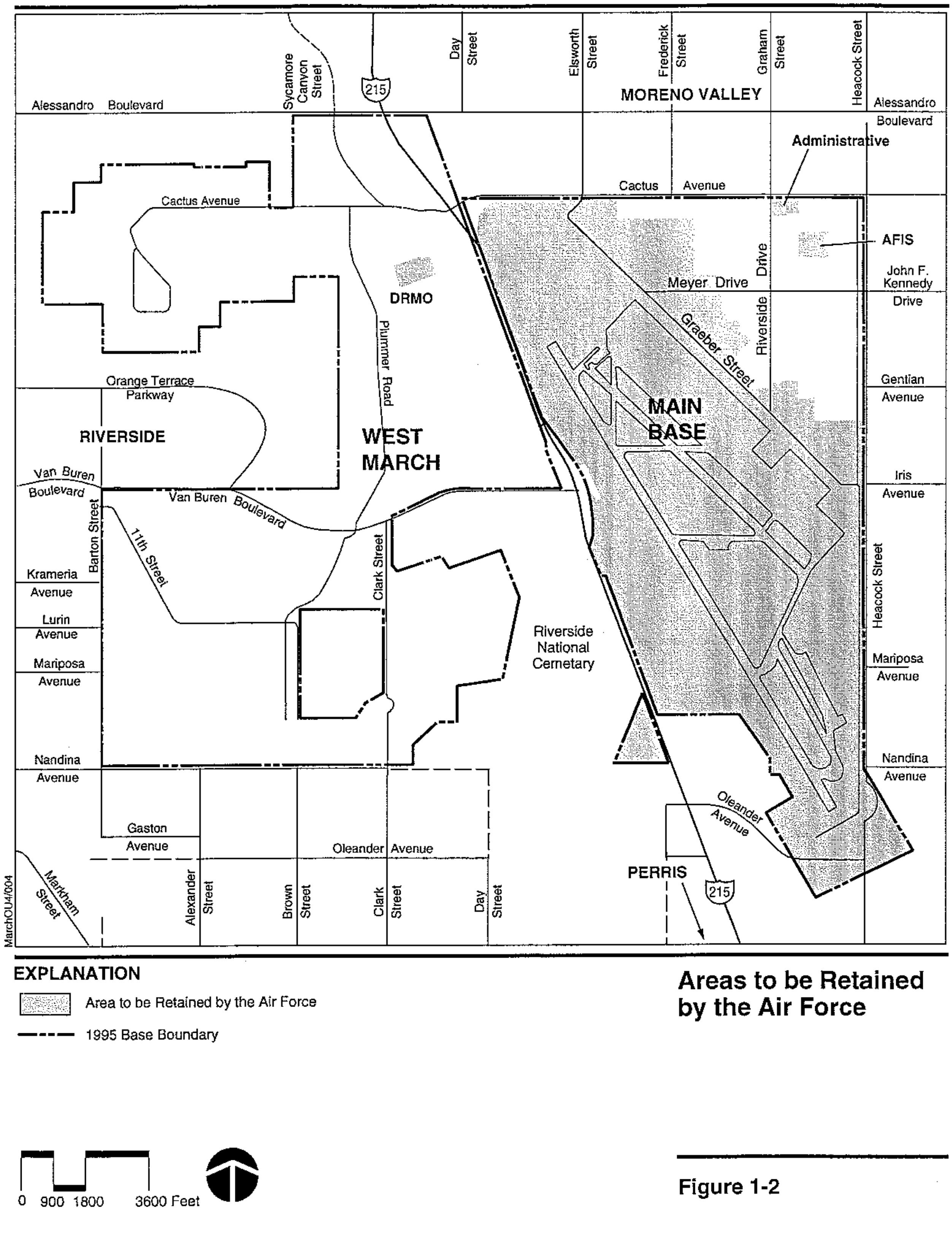
March AFB was designated for realignment under Round III of the Base Realignment and Closure (BRAC) process in September 1994. By March of 1996, all active duty personnel and aircraft had been transferred Air Force Reserve and Air National Guard units remained within the cantonment area of the base, and this portion of the base was designated "March Air Reserve Base" in April 1996. Figure 1-2 shows March as it is today, with the cantonment area (March ARB) to be retained by the Air Force, under charge of the Air Force Reserve Command (AFRC). Closure and transfer of properties outside the cantonment area and within the original March AFB boundary are the responsibility of the Air Force Real Property Agency (AFRPA) and the March Joint Powers Authority (MJPA).



EXPLANATION

Site Location
March AFB

Figure 1-1



Areas to be Retained by the Air Force

Figure 1-2

1.2.1 March AFB/ARB Location and Description

March AFB/ARB encompasses approximately 6,700 acres and is located in the north end of the Perris Valley, east of the city of Riverside and south of the city of Moreno Valley in Riverside County, California. March ARB encompasses approximately 2,000 acres, and the former March AFB under control of the AFRPA encompasses approximately 4,700 acres The base is approximately 60 miles east of Los Angeles and 90 miles north of San Diego. I-215 defines the west boundary of March ARB and bisects the former March AFB in a northwest-southeast direction. Generally, the cantonment area containing March ARB is referred to as the Main Base, and former March AFB property west of I-215 is referred to as West March.

1.2.2 Site History

The Air Force, due to its primary mission in national defense, has long been engaged in a wide variety of operations that involve the use, storage, and disposal of hazardous materials. The IRP was developed by the Department of Defense (DOD) in 1980 to locate and clean up hazardous waste sites

Aircraft maintenance, fuel storage operations, fire-training exercises, and base operations have generated a variety of hazardous wastes. Past waste disposal practices have resulted in contamination of soil and groundwater at several areas on base. The March IRP process began in September 1983. To date, six studies have been completed at March AFB/ARB in support of the IRP. The initial study consisted of employee interviews and review of aerial photographs and base records The records search identified 30 potentially contaminated sites for further investigation. A second study consisting of the collection and analysis of soil, water, and soil gas samples was completed in March 1987. This study indicated that further investigation was needed at 5 of the 30 sites to determine the type and extent of contamination in the soil and groundwater. Further investigation was conducted in June 1987. This investigation indicated that additional work was required to better define the extent of soil and groundwater contamination and to research possible off-base migration of trichloroethylene (TCE) in groundwater

In November 1989, March ARB was listed on the U.S. Environmental Agency's (EPA's) National Priorities List (NPL) primarily due to the presence of contamination in groundwater beneath the base. The NPL is a list of sites considered by the EPA to be of special interest and requiring immediate attention. In September 1990, a Federal Facility Agreement (FFA) was signed by the Air Force, EPA, and the state of California to establish procedures for involving federal and state regulatory agencies and the public in the March ARB environmental restoration process

Three separate OUs were created in order to facilitate the environmental restoration of March ARB in 1991. OUs were created based on geographic location of sites, similarity of contaminants, and location of groundwater contaminant plumes Due to conflicts between FFA deliverable schedules and ongoing site investigations, some sites were removed from their respective OU

RODs OU4, originally defined as the "Basewide Operable Unit", was established in the early 1990s to include sites that were never assigned to or removed from previous OU RODs. However, in 2003, the Basewide OU was changed to OU4 to address remaining IRP sites not covered under other operable units and to address areas of concern where contamination was a potential concern

1.2.3 Previous Investigations at March ARB

Installation Restoration Program. Phase I of the March AFB/ARB IRP began in September 1983 (CH2M Hill, 1984). The Phase I study consisted of interviewing employees and reviewing aerial photographs and base records Eighty-one current and former employees were interviewed and 18 outside agencies were contacted. The record search identified 30 potentially contaminated sites for further investigations, two of which were eliminated from further consideration because only inert rubble (e.g., wood, concrete, metal, etc.) were disposed of at the sites.

Phase II-Stage 1, conducted from October 1985 through March 1987, resulted in a plan to test the 28 sites identified by Phase I (Engineering Science, 1987). Phase II-Stage 1 investigations consisted of collecting soil, soil gas, and water samples from the 28 sites. The results of the Stage 1 investigations indicated that further investigation was needed at five of the 28 sites to determine the type and extent of contamination in the soil and groundwater. The five were IRP Sites 2, 4, 5, 7, and 18.

Based on the results of the Stage 1 investigation, Phase IV Remedial Action was recommended for Site 9 (Main Oil/Water Separator). It was recommended that remedial action be postponed until other contamination in the encompassing area could be evaluated. It was also recommended that No Further Action Decision Documents (NFADDs) be developed for the 22 remaining sites (Engineering Science, 1987). The EPA responded to the NFADDs with a request that follow-up investigative work be performed at most of the sites. This work was accomplished during the completion of the RI/FS for the present OUs. The EPA no longer recognizes NFADDs as a basis for eliminating sites from further investigation, while the Air Force continues to use the NFADD to measure IRP progress.

During Stage 1, three contaminated groundwater wells (one on-base well and two off-base private water wells) were identified as containing concentrations of TCE and tetrachloroethylene (PCE) that exceeded state of California action levels. In June 1986, March AFB began supplying bottled water to the two off-base well owners.

Following completion of the Phase II-Stage 1 on-site work, aerial photographs were reviewed to locate Fire Training Area No. 1 (Site 29). This site was included as a study area for the Phase II-Stage 2 investigation.

In June 1987, the Phase II-Stage 2 investigation began at the five sites recommended for further study in the Phase II-Stage 1 investigation (Engineering Science, 1988), as well as at Site 29. The six sites included Site 2 (Waste Oil Pit/Solvent Tanks), Site 4 (Landfill No. 6), Site 5 (Landfill No 3), Site 7 (Fire Training Area No. 2), Site 18 (Engine Test Cell), and Site 29 (Fire Training Area No. 1). These sites are collectively referred to as "Area 5" due to their close proximity to each other and because the contaminant plumes from these sites appear to be co-mingled.

Stage 2 investigations resulted in the recommendation that additional work be performed at all sites investigated to better define the extent of soil and groundwater contamination, and at Area 5 to investigate the possible off-base migration of TCE in the groundwater

The Phase II-Stage 3 investigation began at Area 5 in July 1988 and was completed in December 1988 (Engineering Science, 1989). The purpose of this investigation was to better define the extent of off-base migration of contaminants by sampling off-base wells Chemical analyses revealed contaminants in both soil and groundwater samples, and the sites were recommended for Phase II-Stage 4 investigations (Engineering Science, 1989).

The Air Force requested that three additional sites be investigated in the Phase II-Stage 4 investigation in addition to the six sites recommended for further investigation during the Phase II-Stage 2 study The investigations assessed potential contamination based on more recent data acquired during non-IRP work. The three sites added to this study for investigations included Site 15 (Fire Protection Training Area), Panero (Site 33), and the Pritchard Aircraft Fueling System Site (Site 34).

The Phase II-Stage 4 (RI/FS) investigation was performed from December 1988 to November 1990 at IRP Sites 2, 4, 18, 15, Area 5, Panero (IRP Site 33), and the Pritchard Aircraft Fueling System Site (IRP Site 34) (The Earth Technology Corporation, 1991). These sites were investigated to assess the extent and magnitude of contamination discovered during earlier studies. Contaminants including petroleum products, chlorinated solvents, and metals were detected in soil and groundwater.

Included in the Phase II-Stage 4 investigation was Fire Protection Training Area (Site 15). This site had been recommended for no further study during the Phase II-Stage 1 investigation. This recommendation was based on limited data and an inventory of past uses of the site (Engineering Science, 1986). Subsequent investigation indicated that percolation of fluids used in fire training exercises could have occurred since the area was not underlain with an impermeable liner. Discolored soil with a distinct JP-4 fuel odor was observed in a trench excavated for the sprinkler lines. Since use of Site 15 may affect human health and the environment, the IRP investigation at Site 15 was continued (Engineering Science, 1986) during Phase II-Stage 4. Use of the Fire Training Area at Site 15 was terminated in March 1991.

Site 17 (swimming pool fill) was recommended for no further study during the Phase II-Stage 1 investigation, but was reconsidered for additional investigation based on new information obtained in 1988. IRP Sites 31, 32, 36, 37, 38, and 39 were added as a result of newly obtained information. By the end of 1990, 39 IRP sites had been identified.

Three additional areas were included in the IRP program in 1991, including Landfill No 8 (Site 40), the Hawes Site (Site 41), and a contaminated sump area at Building 3404, which is within Site 42. Consequently, the known IRP Sites were divided into three OUs in 1991, and the fourth "Basewide" OU was established shortly thereafter Subsequently, the Basewide OU has been changed to OU4. Table 1-2 is a summary of all IRP sites identified to date and their current status. Sites with bold lettering are sites that are evaluated in this OU4 RI/FS document

Scope and Role of Operable Units. The four separate OUs were created in order to facilitate the environmental restoration of March AFB/ARB. Sites included in each OU are as follows (Figure 1-3):

- **Operable Unit 1.** OU1 encompasses fourteen sites, including sites 4, 5, 7, 9, 10, 13, 14, 15, 16, 18, 29, 31, 34, and 38. OU1 includes the on-base and off-base portions of the groundwater plume along the east boundary of March ARB (OU1 Plume).

- **Operable Unit 2.** OU2 originally included twenty-six sites located in West March, the north portion of the Main Base west of Riverside Drive, and the Hawes Site (Site 41). OU2 includes Sites 1, 2, 3, 6, 8, 11, 12, 17, 19, 20, 22, 23, 24, 25, 26, 27, 28, 30, 32, 35, 36, 37, 39, 40, 42, and 43. Sites 28 and 32 were originally listed in the FFA as OU2 Sites. Site 28 is a system of monitoring wells dispersed throughout the main base and is not a source of contamination, so a separate investigation was not warranted. Site 32 was described as an area of construction debris with no location specified. Construction debris was identified as part of Sites 17, 20, and 30. No other specific locations were identified for investigation and further investigation was not warranted. Appendix D of the FFA states that Sites 28 and 32 are not included in the OUs. The Draft Final OU2 Record of Decision (ROD) deliverables addressed all remaining twenty-four OU2 sites (Tetra Tech, 1998a). Site 43, a former underground storage tank site located on West March, was removed from the CERCLA process and was closed by the Regional Water Quality Control Board (RWQCB), Santa Ana Region in 2003. The Air Force has subsequently divided the OU2 sites into an AFRPA ROD and AFRC ROD to expedite property transfer of AFRPA-controlled land.

    - The AFRPA OU2 ROD includes Sites 3, 6, 12, 17, 19, 20, 22, 23, 24, 25, 26, 30, 35, 40, and 42 (fifteen sites).

    - The AFRC OU2 ROD includes Sites 1, 2, 8, 11, 27, 36, 37, and 39 (eight sites).

Table 1-2. Summary of IRP Sites

IRP Site	Site Description	OU	AFRPA versus AFRC Site	Supporting References	Contaminants	Actions/Current Status
Site 1	Aircraft Isolation Area/ Fuel Drainage Area	2	AFRC	AFRC OU2 ROD	Fuels, solvents, and PAHs	Most of the contaminated soil was removed in December 1995. Restricted from residential use.
Site 2	Waste Oil Pits/Solvent tanks	2	AFRC	AFRC OU2 ROD	Fuels, oils, and solvents	Interim remedial action (SVE) is in place.
Site 3	Landfill No. 5	2	AFRPA	AFPRA OU2 ROD	Household waste, oil solvents	Waste was consolidated in the Site 6 landfill. No waste is present.
Site 4	Landfill No. 6	1	AFRPA	OU1 ROD	Household waste, oil, solvents	Landfill was capped in 1995. Waste remains on site. In post-closure O&M.
Site 5	Landfill No. 3	1	AFRC	OU1 ROD	Sanitary waste and construction rubble	Approved for no further action in the OU1 ROD. Waste remains in place. Re-evaluation of long-term protection is required.
Site 6	Landfill No. 4	2	AFRPA	AFPRA OU2 ROD	Household waste, construction rubble	Closed with a new engineered landfill design. Waste remains in place. In post-closure O&M.
Site 7	Fire Protection Training Area No. 2	1	AFRPA	OU1 ROD	Fuels, oils, and solvents	Identified as no further action in the OU1 ROD. ICs have been implemented and deed restrictions/LUCs will be incorporated at property transfer.
Site 8	Flight Line Shop Area/ Operations	2	AFRC	AFRC OU2 ROD	Fuels, oils, and solvents	Some contaminated soils were removed. Waste remains in place.

Table 1-2. Summary of IRP Sites

IRP Site	Site Description	OU	AFRPA versus AFRC Site	Supporting References	Contaminants	Actions/Current Status
Site 9	Oil Water Separator	1	AFRC	OU1 ROD	Fuels, solvents	No contaminants identified above unrestricted levels. Approved for no further action in the OU1 ROD.
Site 10	Flightline Drainage Ditch	1	AFRC	OU1 ROD	Fuels, oils, and solvents, with PAHs in surface soils	Contaminated soils were removed in 1995. No waste remains at site; ESD issued to change remedy.
Site 11	Bulk Fuels Storage Area	2	AFRC	AFRC OU2 ROD	Fuels	Restricted from residential use.
Site 12	Civil Engineering Yard	2	AFRPA	AFPRA OU2 ROD	Oils and solvents	Soil was excavated and placed at the Site 6 landfill; long-term groundwater monitoring is being done.
Site 13	Tank Truck Spill Site (Located within Site 5 Landfill)	1	AFRC	OU1 ROD	Fuels	No contaminants identified above unrestricted levels. Approved for no further action in the OU1 ROD.
Site 14	Liquid Fuel Pump Station Overflow (Near Site 16 Sludge Drying Beds)	1	AFRC	OU1 ROD	Jet fuel	No contaminants identified above unrestricted levels. Approved for no further action in the OU1 ROD.
Site 15	Fire Protection Training Area No. 3	1	AFRC	OU1 ROD	Fuels, BTEX	Contaminated soils were removed in 1995. No waste remains at site; ESD issued to change remedy.
Site 16	East March Sludge Drying Beds	1	AFRC	OU1 ROD	Sludge	No contaminants identified above unrestricted levels. Approved for no further action in the OU1 ROD.
Site 17	Swimming Pool Fill (off Graeber)	2	AFRPA	AFPRA OU2 ROD	Solvents, shop wastes, demolition debris	Pool structure and contents were removed in 1994. Waste remains above unrestricted levels.

Table 1-2. Summary of IRP Sites

IRP Site	Site Description	OU	AFRPA versus AFRC Site	Supporting References	Contaminants	Actions/Current Status
Site 18	Engine Test Cell	1	AFRC	OU1 ROD	Fuels, BTEX	Ongoing discussions with regulators to remove Site 18 from the CERCLA process and manage as a fuels only site. Regulatory oversight by RWQCB only. Modification to OU1 ROD required.
Site 19	West March Sludge Drying Beds	2	AFRPA	AFPRA OU2 ROD	Sludge	Waste remains above unrestricted levels. IC/LUC remedy recommended in the AFRPA OU2 ROD.
Site 20	Landfill No. 7, West March	2	AFRPA	AFPRA OU2 ROD	Household waste	Soil and waste was excavated and placed at Site 6. No waste remains above unrestricted levels at the site.
Site 21	**Effluent Pond (Cordures Property)**	**4**	**AFRPA**	**OU4 RI**	**Treated waste water**	**Site is evaluated in the OU4 RI. Site is an OU4 ROD site.**
Site 22	Landfill No. 2, Main Base	2	AFRPA	AFPRA OU2 ROD	None	Site could not be found. No evidence of waste was identified.
Site 23	East March Effluent Pond, Nadina and Heacock Street	2	AFRPA	AFPRA OU2 ROD	Treated wastewater	No soil contamination was found. No further action recommended.
Site 24	Landfill No. 1, West March, Incinerator Area	2	AFRPA	AFPRA OU2 ROD	Household waste and incinerator ash	Waste and soil was excavated in 1995 and placed at Site 6. No contamination remains above unrestricted levels at the site.

Table 1-2. Summary of IRP Sites

IRP Site	Site Description	OU	AFRPA versus AFRC Site	Supporting References	Contaminants	Actions/Current Status
Site 25	Munitions Residue Burial Site, West March	2	AFRPA	AFPRA OU2 ROD	Munitions residue	Non-hazardous waste was removed and placed at Site 6 in 1995. No contamination remains above unrestricted levels.
Site 26	Water Treatment Sludge, West March	2	AFRPA	AFPRA OU2 ROD	Sludge	Waste was removed and placed at Site 6. No contamination remains above unrestricted levels.
Site 27	Building 422 Underground POL Tanks	2	AFRC	AFRC OU2 ROD	Fuels, oil, and solvent	Tanks were removed. An SVE system will be installed in 2004.
Site 28	Basewide Groundwater Monitoring Wells	--	Not a Site	OU1/OU2 RI/FS	Zone monitoring wells	Well network was part of the basewide groundwater monitoring network. No specific site identified. Not a ROD site.
Site 29	Fire Protection Training Area No. 1	1	AFRC	OU1 ROD	Fuels, oils and solvents	Identified as no further action in the OU1 ROD. ICs will be implemented in the AFRC Base Comprehensive Plan.
Site 30	Construction Rubble Site	2	AFRPA	AFPRA OU2 ROD	Construction rubble	Debris was removed in 1996. Clean up to unrestricted levels reached.
Site 31	Building 1211, Solvent Spill TCE Source Area	1	AFRC	OU1 ROD	Solvents, PAHs	A soil and groundwater treatment system was installed in 1996. Surface soil contamination remains above unrestricted levels. Modification to the OU1 ROD required.

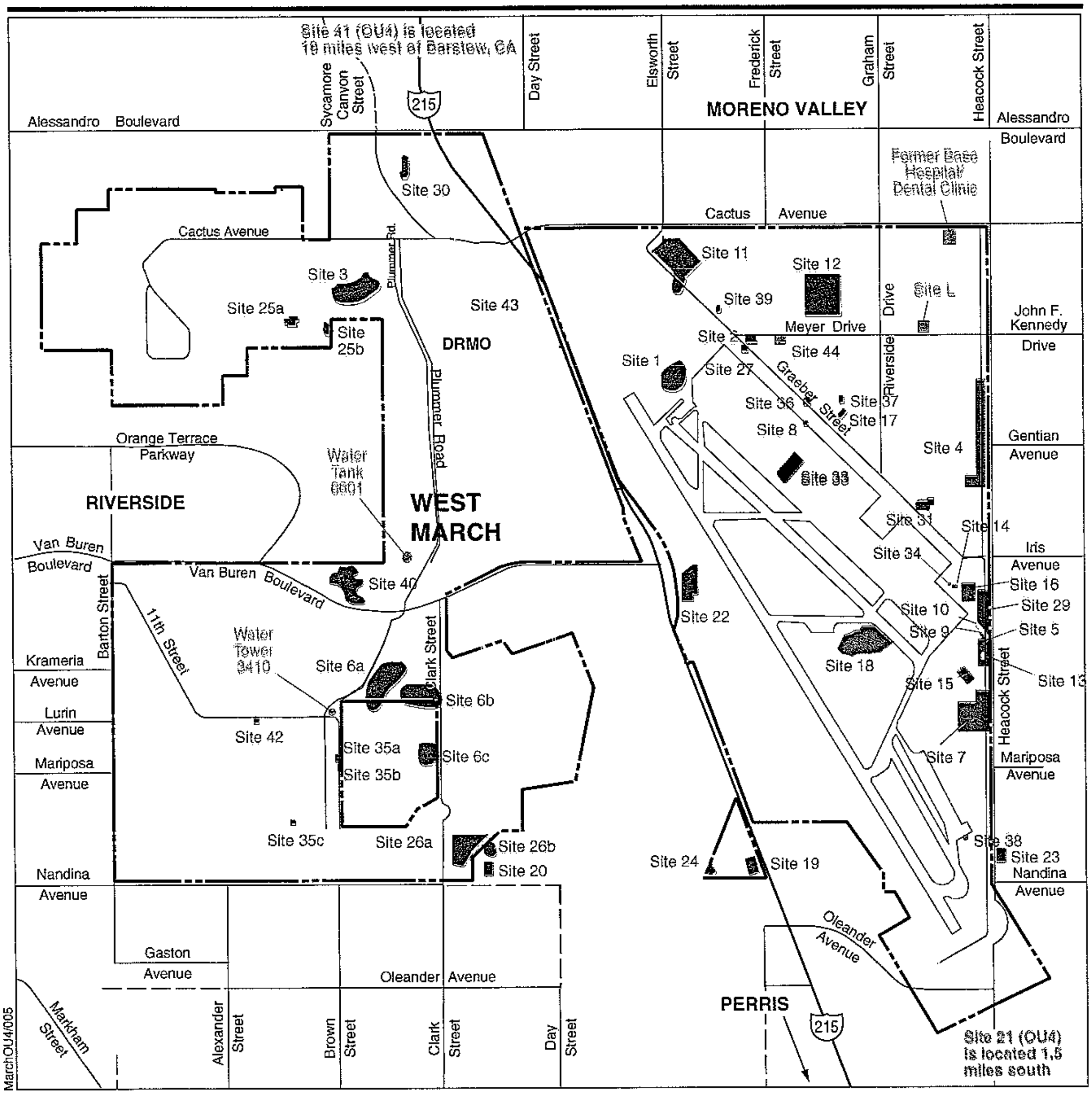
Table 1-2. Summary of IRP Sites

IRP Site	Site Description	OU	AFRPA versus AFRC Site	Supporting References	Contaminants	Actions/Current Status
Site 32	Building Demolition Areas	2	AFRPA	AFRPA OU2 ROD	Assumed to contain construction rubble	Site never found. Site was removed from the IRP list because the sites were not considered to present a risk for adverse affects on human health or the environment. Recommended for no further action.
Site 33	Panero Aircraft Refueling Facility	3	AFRC	OU3 Decision Document	Fuels, BTEX	Ongoing discussions with regulators to remove Site 33 from the CERCLA process and manage as a fuels only site, with regulatory oversight by RWQCB only.
Site 34	Pritchard Refueling System	1	AFRC	OU1 ROD	Fuels, BTEX, PAHs	A biovent pilot study was used to clean the soil. Surface soil contamination remains above unrestricted levels. Modification to the OU1 ROD required.
Site 35	15th Headquarters Leaking UST	2	AFRPA	AFRPA OU2 ROD	Fuels	The USTs were removed and bioventing was used to clean the site.
Site 36	Building 458 Leach Pit	2	AFRC	AFRC OU2 ROD	Solvents	Some contaminated soil was removed in 1994. Groundwater and SVE units are in place and operating.
Site 37	PCB Spill Site at Building 317	2	AFRC	AFRC OU2 ROD	PCBs	Contaminant levels do not represent elevated risk.

Table 1-2. Summary of IRP Sites

IRP Site	Site Description	OU	AFRPA versus AFRC Site	Supporting References	Contaminants	Actions/Current Status
Site 38	PCB Spill Site (former SAC Alert Facility)	1	AFRPA	OU1 ROD	PCBs	The contamination was removed. Site was approved for no further action in the OU1 ROD.
Site 39	Base Gas Station, Building 2406, Main Base	2	AFRC	AFRC OU2 ROD	Fuels	Cleanup is complete.
Site 40	Landfill No. 8, West March	2	AFRPA	AFPRA OU2 ROD	Household waste	Waste was removed in 1996 and placed at Site 6. No waste remains above unrestricted levels.
Site 41	**Hawes Radio Relay Facility, Barstow**	**4**	**AFRPA**	**OU4 ROD**	**Fuels and oil**	**Four USTs were removed in 1995.**
Site 42	15th Headquarters Building 3404 PCB Spill Site	2	AFRPA	AFPRA OU2 ROD	PCBs	Removal and disposal of contaminated soil is complete.
Site 43	Former Automotive Maintenance Area/Cal Trans UST Site	NA	AFRPA	Removed from CERCLA process	Fuels, BTEX	Fuels only site. Removed from the CERCLA process. Cleanup is complete, and site has been closed by the RWQCB.
Site 44	**Base Water Tower No. 407**	**4**	**AFRC**	**OU4 ROD**	**Mercury**	**Contaminated soil was removed in 1997.**

AFRC = Air Force Reserve Command
AFRPA = Air Force Real Property Agency
BTEX = benzene, toluene, ethylbenzene, xylenes
ESD = explanation of significant difference
IC/LUC = Institutional Control/Land Use Covenant
OU = Operable Unit
PAH = polynuclear aromatic hydrocarbon
PCB = polychlorinated biphenyl
ROD = Record of Decision
RWQCB = Regional Water Quality Control Board
SVE = soil vapor/extraction
TCE = trichloroethylene
UST = underground storage tank



EXPLANATION

Base Boundary

Site 28 is a group of monitoring wells spread across the main base

Site 32 is composed of several construction material landfills not currently located

Site in Operable Unit 1

Site in Operable Unit 2

Site in Operable Unit 3

Site in Operable Unit 4

0 900 1800 3600 Feet

OUs and IRP Sites

Figure 1-3

- The Hawes site (site 41) was removed from the OU2 ROD and *included in the OU4 ROD*.

- **Operable Unit 3**. OU3 consists of IRP Site 33 (Panero Aircraft Fueling System) Both soils and groundwater in OU3 have been contaminated by jet fuel, and an SVE system is promoting remediation of both media. OU3 has since been removed from the CERCLA process and will be handled as a RWQCB Underground Storage Tank (UST) Corrective Measures Site with regulatory oversight by the RWQCB, Santa Ana Region.

- **Operable Unit 4**. OU4 includes IRP sites 21, 41, and 44, and non-IRP sites Site L, Water Tower 3410, Water Tank 6601, and the potential release of mercury at the former Base Hospital and Dental Clinic.

Status of Non IRP Sites. Concurrent with the IRP, the Air Force has conducted investigations of sites classified under other environmental programs. Resource Conservation and Recovery Act (RCRA) facility assessment (RFA) sites, environmental baseline survey (EBS) sites, and areas of concern (AOC) have been investigated previously Results of these investigations can be found in the following Air Force documents:

- Site Investigation Summary Report for March Air Force Base, Operable Unit 2, Sites Recommended for No Further Investigation, June 1996, Prepared for Air Mobility Command, Department of the U.S. Air Force, HQ AMC/CEVE; 507 A Street; Scott AFB, Illinois; (U.S. Air Force, 1996a).

- RFA, EBS, and AOC Site Investigation Report for March Air Force Base, Operable Unit 2, Prepared for Air Mobility Command, Department of the U.S. Air Force, HQ AMC/CEVE; 507 A Street; Scott AFB, Illinois; (U.S. Air Force, 1996b).

- Site Investigation Report, Potential Areas of Concern, March Air Reserve Base, Prepared for Air Mobility Command, Department of the U.S. Air Force, HQ AMC/CEVE; 507 A Street; Scott AFB, Illinois; (U.S. Air Force, 1997).

- Tank Removal/Additional Soil Removal, Former Power Generator Station and Former Transformer Area B, March Air Force Base, Prepared for Air Mobility Command, Department of the U.S Air Force, HQ AMC/CEVE; 507 A Street; Scott AFB, Illinois; (U.S. Air Force, 1998a).

- Results of Additional Soil Sampling, Site L, Former NCO Club Swimming Pool, March Air Force Base, Prepared for Air Mobility Command, Department of the U.S. Air Force, HQ AMC/CEVE; 507 A Street; Scott AFB, Illinois; (U.S. Air Force, 1999)

Table 1-3 summarizes the status of Non-IRP Sites, which includes RFA, EBS, and AOC sites identified during various preliminary site assessments and

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
RCRA Facility Assessment Sites						
Site A	No	Building 42 UST	NFA	U.S. Air Force, 1996a	Geophysical survey and soil gas survey performed. VOCs were not detected in soil gas survey.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site B	No	Building 46 UST	NFA	U.S. Air Force, 1996a	Geophysical survey and soil gas survey performed. VOCs were not detected in soil gas survey.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site C	No	Building 49 UST for Cleaning Facility	NFA	U.S. Air Force, 1996b	Methane and TPH (with degraded fuel pattern) were detected at low levels. No other fuel components or volatiles detected. No further action recommended.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Site D	Yes	Building 355 Former Aircraft Wash Area	No further soil investigation required. Groundwater is being dealt with as part of Site 8.	U.S. Air Force, 1996b	Minor soil contamination was found beneath the concrete taxiway. No further action recommended for soil because all soil sample results show concentrations less than residential PRGs. Groundwater contamination is known to exist in this area as part of a nearby basewide solvent plume.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Site E	Yes	Building 1203 Diesel Storage Area	NFA	U.S. Air Force, 1996a	VOCs were not detected in soil gas survey.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site F	Yes	Former Fire Training Burn Pit	NFA	U.S. Air Force, 1996a	VOCs were not detected in soil gas survey.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
Site G	Yes	Facility 1242 Runway Wash Rack/Oil Water Separator	NFA	U.S. Air Force, 1996b	Soil gas and soil samples did not indicate contamination at the end of the runway wash rack area or at the oil/water separator.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Site H	No	Building 1305 Aircraft Parking Area	NFA	U.S. Air Force, 1996a	VOCs were not detected in soil gas survey.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site I	Yes	Building 2312 Materials Spill Area	NFA	U.S. Air Force, 1996b	Soil samples were taken; no contaminant concentrations exceeded residential PRGs. Compliance with Air Force and NFPA standards should be maintained.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Site J	Yes	Building 2314 Potential Burial Site	NFA	U.S. Air Force, 1996a	Geophysical survey performed and subsurface soil sampling conducted during drilling at Site 8 (RI). No debris indicated in geophysical survey; drilling and soil samples did not show contamination.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site K	No	Building 2518, Waste Oil Disposal Site	NFA	U.S. Air Force, 1996a	Soil gas and soil sampling during Site 12 RI did not indicate contamination in the area of the reported disposal site.	The site is recommended for NFA in the AFRPA OU2 ROD.
Site L	No	Building 2706 Former Swimming Pool	Interim removal action complete. site is in long-term monitoring	U.S. Air Force, 1996b U.S. Air Force, 1999	Some residual contamination exists below 10 feet bgs in the pool area. Sampling has been conducted for PCBs in the area surrounding the pool.	The site is in long-term monitoring with semi-annual inspection of the cap. The decision will be codified in the OU4 ROD.

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
Site M	Yes	Flightline Storm Drain, Concrete Ditch	NFA	U.S. Air Force, 1996a	Soil gas survey performed. VOCs were not detected in soil gas survey except for one sample in 46 locations with PCE at 1.14 μg/L.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site N	Yes	Runway Fuel Discharge Area	NFA	U.S. Air Force, 1996a	VOCs were not detected in soil gas survey.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site O	Yes	Waste Disposal Hole	NFA	U.S. Air Force, 1996a	No positive location could be established for this site, but indications are that it may be Site 31.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site P	No	UNK 1, Possible Landfill	NFA	U.S. Air Force, 1996b	No evidence of landfilling or buried debris found.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Site Q	Yes	Main Aircraft Parking Area (UNK2)	NFA	U.S. Air Force, 1996a	Soil gas survey performed. VOCs were detected at 4 of 135 locations with mostly petroleum-related contaminants.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site R	Yes	Buried Evaporation Pond (UNK4)	NFA	U.S. Air Force, 1996a	Since the exact location of the pond could not be established and this area is being investigated under Site G-Facility 1242 and OU1 IRP Sites 14 and 34, specific sampling for this site was not required.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site S	No	Possible Spill Area (UNK 5)	NFA	U.S. Air Force, 1996a	VOCs were not detected in soil gas survey.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
Site T	Yes	Possible Spill Area (UNK 6)	NFA	U.S. Air Force, 1996a	VOCs were not detected in soil gas survey.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site U	Yes	Possible Spill Area (UNK 7)	NFA	U.S. Air Force, 1996a	This area has been significantly altered and disturbed with the construction of Taxiway #2. Therefore, sampling of surface soils, noted to be stained, is not feasible.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site V	Yes	Possible Spill Area (UNK 8)	NFA	U.S. Air Force, 1996a	VOCs were not detected in soil gas survey.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site W	Yes	Possible Spill Area (UNK 9)	NFA	U.S. Air Force, 1996a	This area has been significantly altered and disturbed with the construction of Runway 2-30. Therefore, sampling of surface soils, noted to be stained, is not feasible.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site X	Yes	Former Excavation (UNK 10)	NFA	U.S. Air Force, 1996a	VOCs were not detected in soil gas survey.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Site Y	No	Possible Landfill	FUDS	U.S. Air Force, 1996b	Evidence of landfilling ash and construction debris. Sample results show high metals content and some PAHs.	This is a USACE FUDS Site.
Site Z	No	Possible Landfill	NFA	U.S. Air Force, 1996b	Surface debris was removed; no evidence of buried waste was found.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
Site AA	No	Trench	NFA	U.S. Air Force, 1996b	No evidence of buried waste was found. No detected contaminants in surface samples were above residential PRGs	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Site DD	No	Possible Fill Area	NFA	U.S. Air Force 1996a	This area has been significantly altered and disturbed with the construction of the cemetery. Therefore, sampling of surface soils noted to be stained, is no longer feasible.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Environmental Baseline Survey Sites						
Area Q-4,7	No	Smoke Grenades/ Debris	NFA	U.S. Air Force, 1996a	A visual site inspection revealed burn areas, but no construction rubble or spent grenades were identified.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Area N-4,7	No	Subsidence	NFA	U.S. Air Force, 1996a	A visual site inspection showed significant grading activities have occurred. No evidence of subsidence could be found during the site inspection.	The report was issued as final: and approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Area Q7,7	No	Debris	NFA	U.S. Air Force, 1996a	A site inspection did not reveal evidence of debris.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Area U2,7	No	Debris	NFA	U.S. Air Force, 1996a	Debris was observed in a reconnaissance subsequent to the EBS, but no evidence of environmental concerns associated with the debris were noted.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
Area S-2,7	No	Suspect Vehicle Site/Area of Stressed Vegetation	NFA	U.S. Air Force, 1996a	A subsequent reconnaissance indicated stressed vegetation was the result of poor substrate. Notations on maps indicated this was a military police training area for inspection of vehicles.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Area A	Yes	Facility 2274 and 2305 Surface Soil Staining	NFA	U.S. Air Force, 1996a	Paving at Facility 2274 has disturbed potential stained soils so that sampling is no longer feasible. Staining at Facility 2305 was associated with a waste accumulation point and is a compliance issue.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Area BB-1,7	No	Small Arms Range Drainage Ditch	NFA	U.S. Air Force, 1996a	Considerable construction activities have occurred in this area, including a removal action at Site 26, installation of a pipeline and road work. Soils of concern have been moved or removed, and are no longer available for sampling. Further investigation was not warranted.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Main Base	Yes	Former Target Butt	NFA	U.S. Air Force, 1996a	Considerable construction activities associated with the runway have occurred in this area. A subsequent site reconnaissance did not reveal a target berm.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Area P-2,7	No	Oil Mat	NFA	U.S. Air Force, 1996a	Considerable construction has occurred in this area. Soils associated with this site could not be sampled.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
Area A-28,1	Yes	Oil Mat	NFA	U.S. Air Force, 1996a	Considerable construction has occurred in this area. Soils associated with this site could not be sampled.	The report was issued as final: approval of draft final received from U.S. EPA, Cal EPA, and RWQCB.
Area N-3,7	No	Oil Mat	NFA	U.S. Air Force, 1996b	Surface soil sampling did not show evidence of contamination.	The report was issued as final: Approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Area Q-6,7	No	Drums	NFA	U.S. Air Force, 1996b	Drum samples did not indicate contaminant concentrations exceeding residential PRGs.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Area Q-8,7	No	Fill Material/-Construction Debris	NFA	U.S. Air Force, 1996b	Surface soil samples did not indicate contaminant concentrations exceeding residential PRGs	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Site 549	No	Staining at Facility 549	NFA	U.S. Air Force, 1996b U.S. Air Force, 1998	Soil stained with oils was detected. Soils were removed and disposed during tank removal activities.	Approval received from the RWCQB.
Site T	No	Facility 5044 Transformer Leak	NFA	U.S. Air Force, 1996b	Sampling showed no detectable PCBs.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Site U-5,7	No	Surface Debris/Soil Mounds	NFA	U.S. Air Force, 1996b	Surface sampling showed no detectable PCBs, petroleum hydrocarbons, or pesticides. One PAH was detected in one sample at levels below residential PRGs.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
Site U-4,7	No	Buried Drum/Rows of Pits	NFA	U.S. Air Force, 1996b	Samples did not indicate compound concentrations exceeding residential PRGs. Pits/drums may be associated with training activities (field latrines).	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Site Z-3,7	No	Former Emergency Power Generator Facility	NFA	U.S. Air Force 1996b; U.S. Air Force 1998	The UST and associated contaminated soil was removed.	Approval received from RWQCB and Cal EPA.
Site Z	No	Former Transformer Areas	NFA	U.S. Air Force, 1996b U.S. Air Force, 1998	Area C did not show PCB concentrations greater than residential PRGs. Soil was removed from Areas A and B to unrestricted levels.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA for 1996b report. Letter from U.S. EPA was received May 2000 approving the March 2000 report documenting additional removal at Area B.
Site STP	Yes	Former Sewage Treatment Plant	NFA	U.S. Air Force, 1996b	Soil samples show some organic compounds, but no concentrations in excess of industrial PRGs	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Site 8, Facility 355/373	Yes	Wash Rack	Removal	U.S. Air Force, 1996b; U.S. Air Force, 1997	Soil and groundwater contamination found. Further delineation of contamination will be conducted as part of the IRP Site 8 Investigation under the AFRC OU2 ROD.	Part of the AFRC OU2 RI/FS and ROD.

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
Facility 458	Yes	Wash Rack/drainage Waste Storage Area	NFA	U.S. Air Force, 1996b	Soil samples did not indicate contamination associated with the wash rack. No further investigation was required.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Facility 479	Yes	Wash Rack	NFA	U.S. Air Force, 1996b	Soil samples did not indicate contamination associated with the wash rack. No further investigation was required.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Main Base and West March (Sites V-2,7, Z-3,7, and A-2,7)	Both	Skeet Ranges	NFA	U.S. Air Force, 1996b	Soil samples did not indicate lead contamination.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Water Tank - Building 6601	**No**	**Water Tank 6601 Mercury**	**NFA**	**OU4 RI/OU4 ROD**	**Contaminated soil has been removed. Site is being investigated in the OU4 RI and will be recorded in the OU4 ROD.**	**Site investigation and conclusions will be codified in the OU4 ROD.**
Water Tank Building 3410	**No**	**Water Tank 3410 Mercury**	**NFA**	**OU4 RI/OU4 ROD**	**Contaminated soil has been removed. Site is being investigated in the OU4 RI and will be recorded in the OU4 ROD.**	**Site investigation and conclusions will be codified in the OU4 ROD.**
March Base Hospital/ Dental Clinic	**No**	**Former March Hospital and Dental Clinic**	**NFA**	**OU4 RI**	**The Site was investigated in 2002 and found to not contain mercury levels above unrestricted levels.**	**The site investigation will be codified in the OU4 ROD.**
Areas of Concern						
Main Base	Both	Buildings with Crawl Spaces	NFA	U.S. Air Force, 1996b	Some buildings had evidence of elevated levels of pesticides in the crawl spaces.	Pesticides were applied by licensed pest control personnel. The site is not considered a CERCLA release site.

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
Gregory Well Building	No	Transformer Spill	NFA	U.S. Air Force 1996b	No PCBs were detected in sampling.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
15th Air Force HQ	No	Cooling Tower	NFA	U.S. Air Force 1996b	Sampling did not detect hexavalent chromium in soils around the tower.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
JP-4 Pipeline	Yes	Potential Leakage	NFA	U.S. Air Force, 1996b	Soil gas survey did not indicate significant levels of petroleum hydrocarbons in subsurface soil.	The report was issued as final: approval received from Cal EPA and RWQCB. No approval letter was received from U.S. EPA.
Golf Course	No	Pesticide Spillage	NFA	U.S. Air Force, 1996b	Some pesticides were detected but at concentrations less than 10^{-5} residential risk levels.	The report was issued as final: approval received from Cal EPA and RWQCB. Property was transferred with regulatory approval.
Building 426	Yes	Potential Solvent Source	NFA	U.S. Air Force, 1997	Deep soil gas survey performed. No indications of significant source.	No comments were received. Site will be addressed in AFRC OU2 ROD.
Building 434	Yes	Potential Solvent Source	NFA	U.S. Air Force, 1997	Deep soil gas survey performed. No indications of significant source.	No comments were received. Site will be addressed in AFRC OU2 ROD.
Building 453	Yes	Potential Solvent Source	NFA	U.S. Air Force, 1997	Deep soil gas survey performed. No indications of significant source.	No comments were received. Site will be addressed in AFRC OU2 ROD.

Table 1-3. Summary of Non-IRP Investigations

Site	Cantonment	Building & Concern	Status	Report Reference	Studies Performed and Summary Results	Regulatory Concurrence
Incinerator, Main Base	Yes	Potential Metals, PAH Source	NFA	U.S. Air Force, 1997	Sampling performed. No indications of ash or contamination associated with incinerators.	No comments were received.

AFRC = Air Force Reserve Command
bgs = below ground surface
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
EPA = *Environmental Protection Agency*
FS = feasibility study
FUDS = formerly used defense site
NFA = no further action
NFPA = National Fire Protection Association
OU = operable unit
PCBs = polychlorinated biphenyls
PRG = USEPA Region IX Preliminary Remediation Goal
RI = remedial investigation
ROD = Record of Decision
RWQCB = Regional Water Quality Control Board
TPH = total petroleum hydrocarbon
UNK = unknown
USACE = U.S. Army Corps of Engineers
UST = underground storage tank
VOCs = volatile organic compounds

environmental baseline surveys. The sites in "bold" text are sites that are addressed in detail in this Focused OU4 RI document. The table includes disposition of 28 RFA sites, 24 EBS sites, and 9 AOCs, including: site location inside or outside the current cantonment, building and environmental concern, site status, report reference, a description of investigations performed, and regulatory concurrence

2.0 PHYSICAL CHARACTERISTICS AND ENVIRONMENTAL SETTING

The following sections present a summary of existing information on the physical characteristics and the environmental setting for March AFB/ARB

2.1 PHYSIOGRAPHY AND TOPOGRAPHY

March AFB/ARB is located in the western region of Riverside County, California, within the northern part of the Peninsular Ranges Geomorphic Province as defined by Norris and Webb (1990). The region around March AFB/ARB is characterized by rugged mountain ranges composed of igneous and metamorphic rocks, broad erosional plains composed of deeply eroded sedimentary and crystalline basement rocks, and a broad, flat valley composed of younger alluvial material. Other major features in the area include the Pacific Coastal Plain to the west, the Transverse Ranges to the north, and the San Jacinto Mountains and the Colorado Desert to the east (Engineering Science, 1988).

The main base (area east of I-215) lies within the Perris Valley, a sub-basin of the San Jacinto watershed. West March lies east of I-215 on an elevated surface called the Perris Erosional Surface. The Perris Valley is a semi-arid, north-south trending alluvial valley bounded by low-lying granitic bedrock on the west and a series of tributary valleys and granitic mountains on the east (CH2M Hill, 1984). The valley floor has a gentle slope of approximately 20 feet per mile in a south-southeasterly direction. The Perris Erosional Surface is characterized by crystalline rock outcrops with shallow soil cover and characterizes the West March area (west of I-215) with hilly terrain and small canyons.

Ground surface elevations at March AFB/ARB range from approximately 1,465 feet above mean sea level (MSL) in the southeast to approximately 1,760 feet above MSL in the northwest. The Box Springs Mountains, 4 miles north of the base, reach elevations of 3,000 feet above MSL, and the Mount Russell Range, 2.5 miles east of the base, reaches an elevation of 2,700 feet above MSL. The base and surrounding area occupy portions of the Perris, Riverside East, Steele Peake, and Sunnymead Quadrangles (USGS, 1967a, 1967b, 1967c, and 1967d).

2.2 GEOLOGY

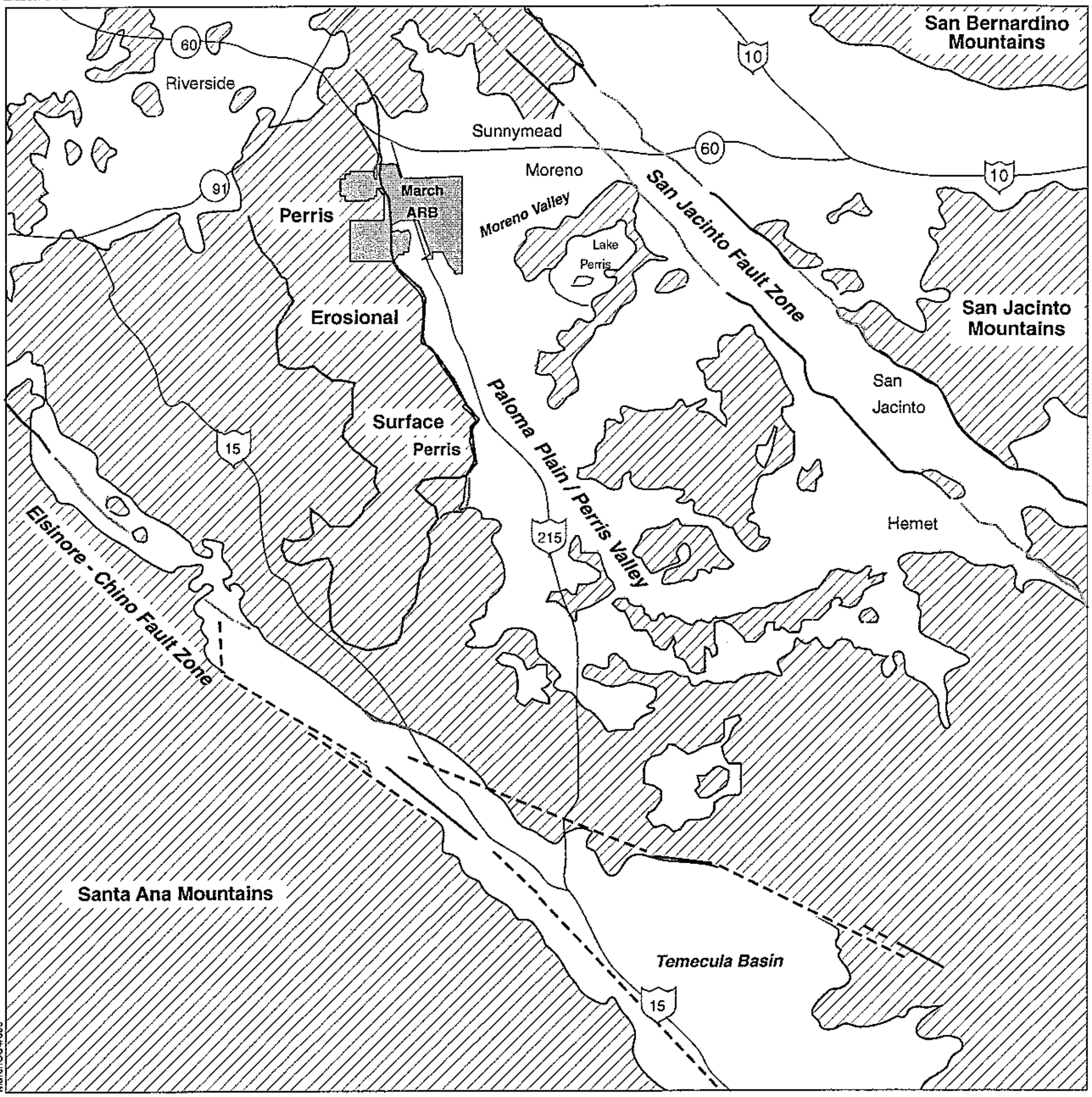
The regional geology surrounding March AFB/ARB is characterized by igneous and metamorphic crystalline rock overlain, or outcropping through, alluvial sediments. March AFB/ARB lies within the northern part of the Peninsular Ranges Geomorphic Province. The Peninsular Ranges are a northwest to southeast oriented complex of blocks separated by similarly trending faults (Tetra Tech, 2000). Within the Peninsular Range, March ARB lies on an eroded mass of Cretaceous and older crystalline rock that is known as the Perris Block.

The Perris Block is bounded on the west by the Elsinore-Chino fault zone and on the east by the San Jacinto fault zone. The Elsinore-Chino fault zone is approximately 14 miles southwest of the base and the San Jacinto fault zone is approximately 7 miles northeast of the base (Figure 2-1) The Casa Loma Fault, a subparallel splay of the San Jacinto Fault Zone, is located approximately 5 miles northeast of the base and trends southeast from Reche Canyon to approximately 5 miles east of the Perris Reservoir Dam (Tetra Tech, 2000). Movement along these fault zones is predominantly right lateral strike slip accompanied by a smaller component of dip slip movement Strike slip movement along these faults range from 3 to 18 miles since mid-Cretaceous time, with vertical displacement of several hundred to a few thousand feet (Woodford et al., 1971).

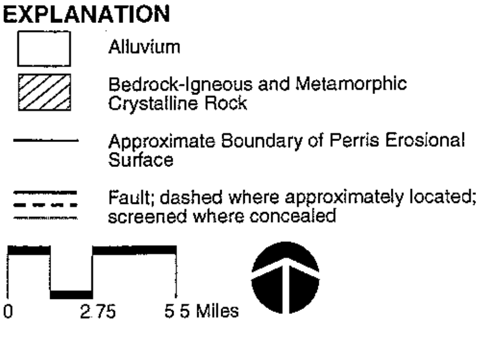
The bedrock at and around March AFB/ARB is granitic in composition, ranging from granodiorite to tonalite. These rocks are well laminated and moderately jointed, and exposed rocks often weather to large boulders (Tetra Tech, 2000) The subsurface bedrock is characterized by a highly weathered zone near the bedrock-alluvium interface. Drilling records indicate that the weathered bedrock material can be up to 150 feet thick over the bedrock highs, and as thin as 10 feet or less over areas of buried bedrock channels. Additionally, drilling data show that the upper portion of the weathered bedrock is saturated, transmits water, and has characteristics similar to tighter, finer-grained sediments (Tetra Tech, 2000). Bedrock exposures can be observed in numerous locations on West March and at isolated locations within the Main Base area (particularly south of Taxiway 2 near the former Engine Test Cell).

In the subsurface, three prominent buried bedrock highs can be observed beneath March ARB, exclusive of Former West March AFB/ARB (Figure 2-2) (Tetra Tech, 2000). Based on geophysical data, one bedrock high is situated at the northern end of the base just north of the intersection of Meyer Drive and Graeber Street. A second bedrock high is near the central part of the main cantonment area beginning just north of the intersection of Graeber Street and Riverside Drive (Graeber Bedrock Ridge) and extending southeast to the former base boundary near Iris and Heacock streets just east of the former base boundary. The third and largest of the bedrock highs is south of Taxiway 2 and trends southeast parallel to the active runway to the south end of the former base boundary (Runway Bedrock Ridge). Scoured bedrock channels between these bedrock highs appear to coalesce with the deeper bedrock tributary channel that runs parallel to I-215 to the west. The bedrock surface is at the ground surface just south of the Engine Test Cell; however, the bedrock surface is in excess of 400 feet bgs in the bedrock channel just west of the Engine Test Cell, near the active runway.

The bedrock contour map generated by the University of California Riverside reflects the morphology of the bedrock surface at depth; however, the exact depth of the bedrock surface may vary by 30 feet or more. From an aquifer standpoint, the bottom of the aquifer is probably best depicted by the bedrock map.

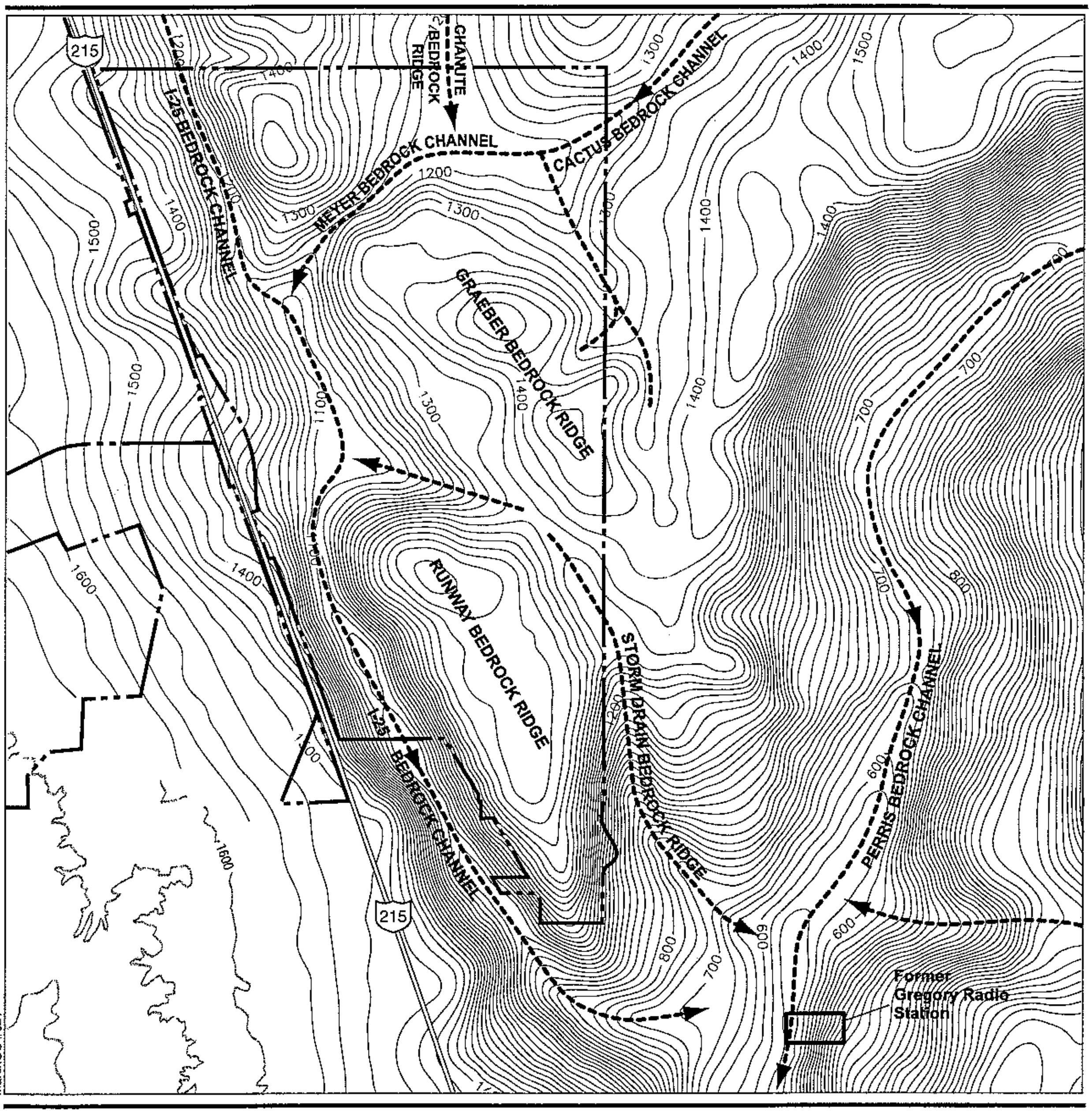


EXPLANATION



General Geologic Map

Figure 2-1



Bedrock Elevation Map

0 800 1600 3200 Feet

Source: Bedrock Elevation Map from UCR Gravimetric Study (Lee 2000)

Figure 2-2

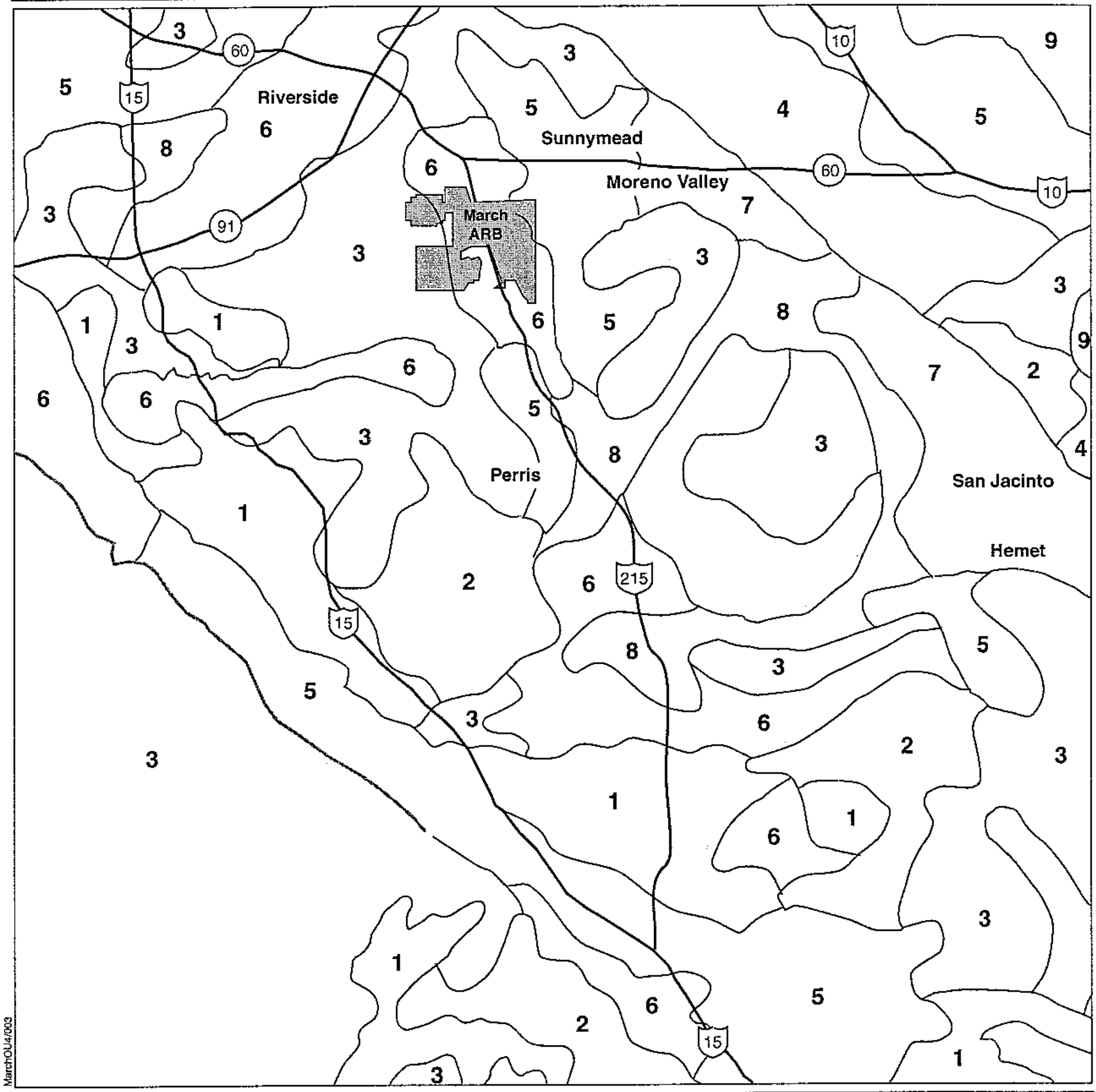
The Perris Valley consists of deeply eroded bedrock subsurface that was subsequently filled with alluvium. The alluvial material consists of interbedded layers of gravel, sand, silt, and clay of varying thickness The thickness of the alluvial deposits range from a few feet thick, in areas of bedrock highs, to over 900 feet thick southeast of the base (Tetra Tech, 2000). The land surface on base and extending off base to the southeast generally slopes to the southeast at 15 to 20 feet per mile. This plain forms the northern part of the Paloma Surface described by Morton, et al. (1997) and Woodford, et al. (1971). Development of the channelized bedrock surface was followed by a period of non-marine sedimentation. Drainage shifted toward the west and the Perris Surface was deeply eroded, depositing recent alluvium and forming the relatively flat Paloma Surface/Perris Valley (Woodford, et al., 1971). Drilling records have revealed that these alluvial deposits are extremely heterogeneous in particle size and distribution, resulting in hydraulic properties that are also highly variable.

Two major soil associations exist in the March AFB/ARB area: the Cieneba-Rockland-Fallbrook association and the Monserate-Arlington-Exeter association (Figure 2-3). The Cieneba-Rockland-Fallbrook association is derived from granitic rock and occurs on the West March portion of the former base These soils are typically 1 to 3 feet thick, have a surface layer of sandy loam to fine sandy loam, are well drained, coarse- to medium-grained, and have slopes ranging from 2 to 50 percent. The soils occur on undulating to steep terrain, such as granitic rock uplands and low mountains. The Monserate-Arlington-Exeter association is a soil derived from granitic alluvium and occurs on the eastern portion of the base (Main Base). These soils have a surface layer of sandy loam to loam, are well drained, fine- to medium-grained, and gently sloping. The soils are typically underlain by a shallow, relatively low permeability silica hardpan at a depth of 28 to 50 inches, resulting in a moderately high runoff potential. These soils occur on alluvial fans, terraces, and valleys (Engineering Science, 1988).

Detailed discussions of the base geology can be found in the OU1, OU2, and OU3 RI/FS reports (Earth Tech, 1994; Tetra Tech, 1997b; and Idaho National Engineering Laboratory, 1993) and in the Regional Basin Evaluation Report prepared by Tetra Tech (2000).

2.3 HYDROGEOLOGY

Groundwater beneath the Main Base generally occurs in the alluvial deposits. The bedrock is considered non-water bearing, with the exception of groundwater that occurs in joints or fracture zones, or in the weathered zones that exist in some areas of the bedrock-alluvium contact. The water-bearing zones vary in thickness and composition throughout the base. There is no single water-bearing zone that can be traced continuously across the base (Tetra Tech, 1997c). The strata are discontinuous and may interfinger with adjacent alluvial units. In general, the water-bearing zones consist of varying amounts of sandy zones (with occasional gravel lenses) separated by leaky confining beds of finer-grained silts and clays (Tetra Tech, 1997c). These deposits are moderately to highly permeable and capable of yielding large amounts of water under



MarchOU4/003

EXPLANATION

—— Boundary between soil associations; screened where inferred/extrapolated

1	Cajalco-Temescal-Las Posas
2	Friant-Lodo-Escondido
3	Cienba-Rockland-Fallbrook
4	Badland-San Timoteo
5	Hanford-Tujunga-Greenfield
6	Monserate-Arlington-Exeter
7	San Emigdio-Grangeville-Metz
8	Traver-Domino-Willows
9	Tollhouse-Sheephead-Crafton
10	Mottsville-Calpine-Oak Glen

0 1 2 4 Miles

Source: U.S. Dept of Agriculture, U.S. Dept. of Interior; University of California Agricultural Experiment Station 1971

General Soil Map

Figure 2-3

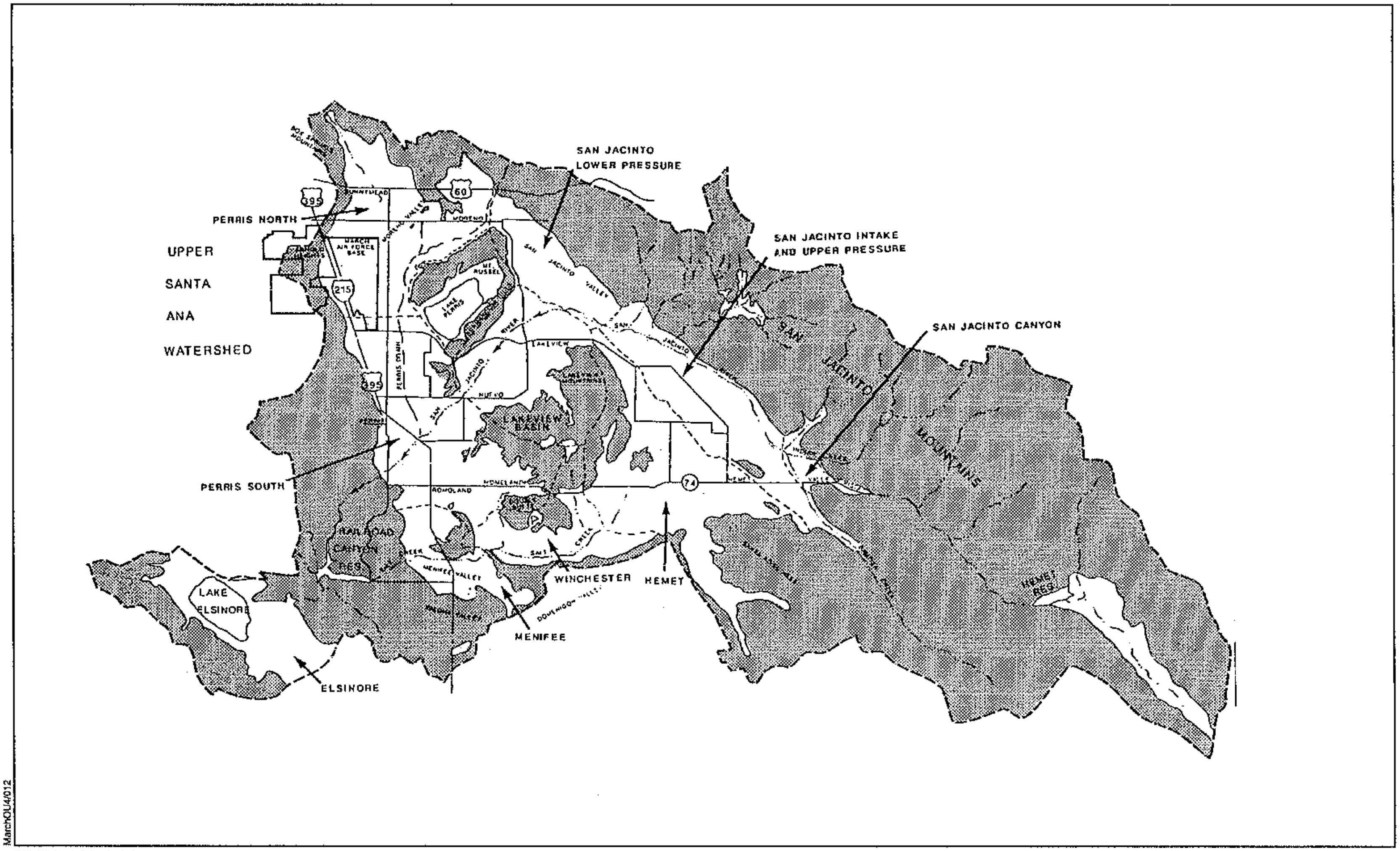
unconfined conditions. Based on previous studies, the permeability of the alluvium varies both laterally and vertically.

Groundwater beneath West March generally occurs under unconfined conditions in shallow alluvial deposits and in weathered bedrock (Tetra Tech, 1997b). Although the amount of fracturing in the weathered bedrock is unknown, in general, unweathered crystalline rocks occur within tens of meters of the ground surface. However, in some cases, this depth can be hundreds of meters from the ground surface. In general, a decrease in permeability with depth is observed in crystalline rocks. Seasonal rainfall can produce significant groundwater elevation changes with the highest groundwater elevations occurring in early spring. Rises in water levels on the order of 5 to 10 feet can occur after heavy rains (Tetra Tech, 1997b).

OU-specific hydrogeology discussions can be found in their respective RI reports (The Earth Technology Corporation, 1994; Tetra Tech, 1997b; and Idaho National Engineering Laboratory, 1993). A detailed analysis of the regional groundwater conditions on and surrounding March AFB/ARB can be found in the Regional Basin Evaluation Report prepared by Tetra Tech (2000).

The groundwater system in the Perris and Moreno Valleys (San Jacinto Groundwater Basin) is almost completely surrounded by non-water-bearing rocks (Figure 2-4) such that water flowing into or out of the basin should be negligible (California Department of Water Resources, 1978). Natural recharge to the aquifer results primarily from infiltration of precipitation. Artificial recharge on base occurs from infiltration of irrigation water near the central portion of the base shop and housing areas and from the Perris Valley Storm Drain located along the east side of the Main Base. Infiltration of irrigation water and seepage from unlined canals and septic systems also contributes to the artificial recharge.

Historically, the amount of water removed by pumping often exceeded the amount of water naturally recharged to the aquifer. Pumping has caused groundwater levels in some wells to decrease by as much as 185 feet between 1941 and the mid 1980s (CH2M HILL, 1984; Engineering Science, 1988). Monitoring of groundwater levels on-base since 1987 indicates a local rise in groundwater levels. Changes in land use, most notably a reduction in the amount of agricultural land and an increase in urbanization, have resulted in a rising water table. Specifically, reductions in the amount of groundwater withdrawal caused by decreased use of agriculture and increased surface infiltration has resulted in rising water tables. In recent years, the filling of the Perris Reservoir southeast of the base, and subsequent seepage below and across the earth-filled dam are also a suspected contributor to recharge and rising water levels in the basin. Based on Tetra Tech's groundwater elevation trend analysis conducted on data collected between July 1992 and April 1996, groundwater elevations increased on the Main Base an average of 2.54 feet per year (Tetra Tech, 1997c). Groundwater levels at West March usually rise and fall seasonally.



MarchOU4/012

EXPLANATION

- Streams Showing Direction of Flow
- Watershed Boundary
- Subbasin Boundary
- HEMET Subbasin Name
- Nonwater-bearing Rock

0 3.5 7 Miles

San Jacinto Groundwater Basin

Figure 2-4

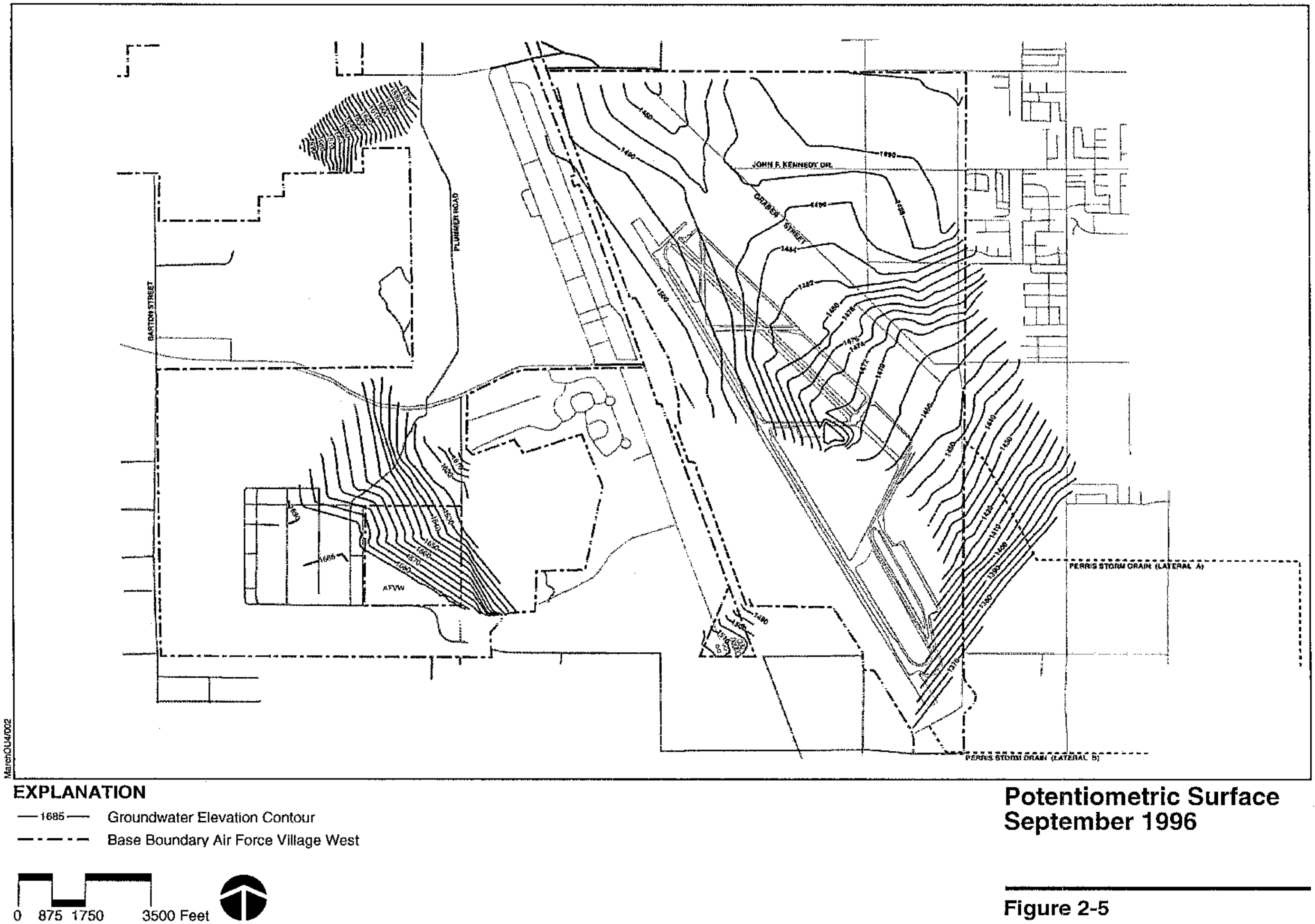
Groundwater generally flows toward the southeast across the Main Base (Figure 2-5). This southeasterly direction is consistent with the regional flow in this portion of Perris Valley. Tetra Tech identified a groundwater high from the September 1996 groundwater elevation data in the vicinity of IRP Site 2 near the north-central portion of the Main Base (Tetra Tech, 1997c) It is assumed that this groundwater high may be associated with the bedrock high observed in this area. The groundwater gradient in the northern portion of the base is relatively gentle but steepens at the southeast portion of the base Groundwater flow across the flightline flows in an easterly direction where it eventually diverges near the parking apron to the southeast. In the north portion of the Main Base, groundwater elevations indicate the direction of flow toward the north This northern flow may be caused by groundwater withdrawal in production wells north of the base or may be the result of a buried channel thought to exist in this area (Tetra Tech, 1997c)

At West March, groundwater flows toward the northeast in the northwest portion of West March. This same groundwater flow direction is observed in the southeastern portion of West March, but at some point, the flow diverges toward the southeast. The exact location of this divergence is unknown. In addition, it is unknown if this area is influenced by a fault or some other groundwater barrier (Tetra Tech, 1997b). The quality of groundwater in the northern portion of the Perris Valley and Moreno Valley is considered good. Total dissolved solids (TDS) concentrations in these areas range from 250 parts per million (ppm) to 1,000 ppm In the southern region of Perris Valley, south of the base, TDS values in excess of 12,000 ppm occur. The poorest groundwater quality occurs near the San Jacinto River, where brackish water has formed as a result of large evapotranspiration losses during the past high groundwater table conditions. TDS concentrations in areas north and south of the river increase as groundwater levels decline in response to increased pumping in areas of better quality water Pumping wells have periodically been abandoned in these areas as brackish water moved into the pumping zones (Engineering Science, 1988).

The mineral content of groundwater in and between the various sub-basins of the San Jacinto River Basin varies considerably. Relatively high concentrations of boron and fluoride occur in some portions of the San Jacinto River Basin and may be associated with local features such as unmapped faults. High nitrate concentrations found in some portions of the basin are attributed to agricultural activities Groundwater in the basin is considered hard to very hard with concentrations of calcium carbonate ranging from 120 ppm to 200 ppm locally (Engineering Science, 1988).

2.4 SURFACE WATER AND DRAINAGE

The Main Base and all IRP sites (with the exception of the Hawes site [Site 41]) lie within the San Jacinto watershed, one of three major geographical subdivisions of the Santa Ana Basin (see Figure 2-4). The San Jacinto watershed encompasses 760 square miles, and the San Jacinto River is a major drainage feature. The northwest corner and part of the southwest corner of the base lie within the Upper Santa Ana watershed and drain to tributaries of the Upper Santa Ana River (CH2M Hill, 1984; Engineering Science, 1988). The



Potentiometric Surface
September 1996

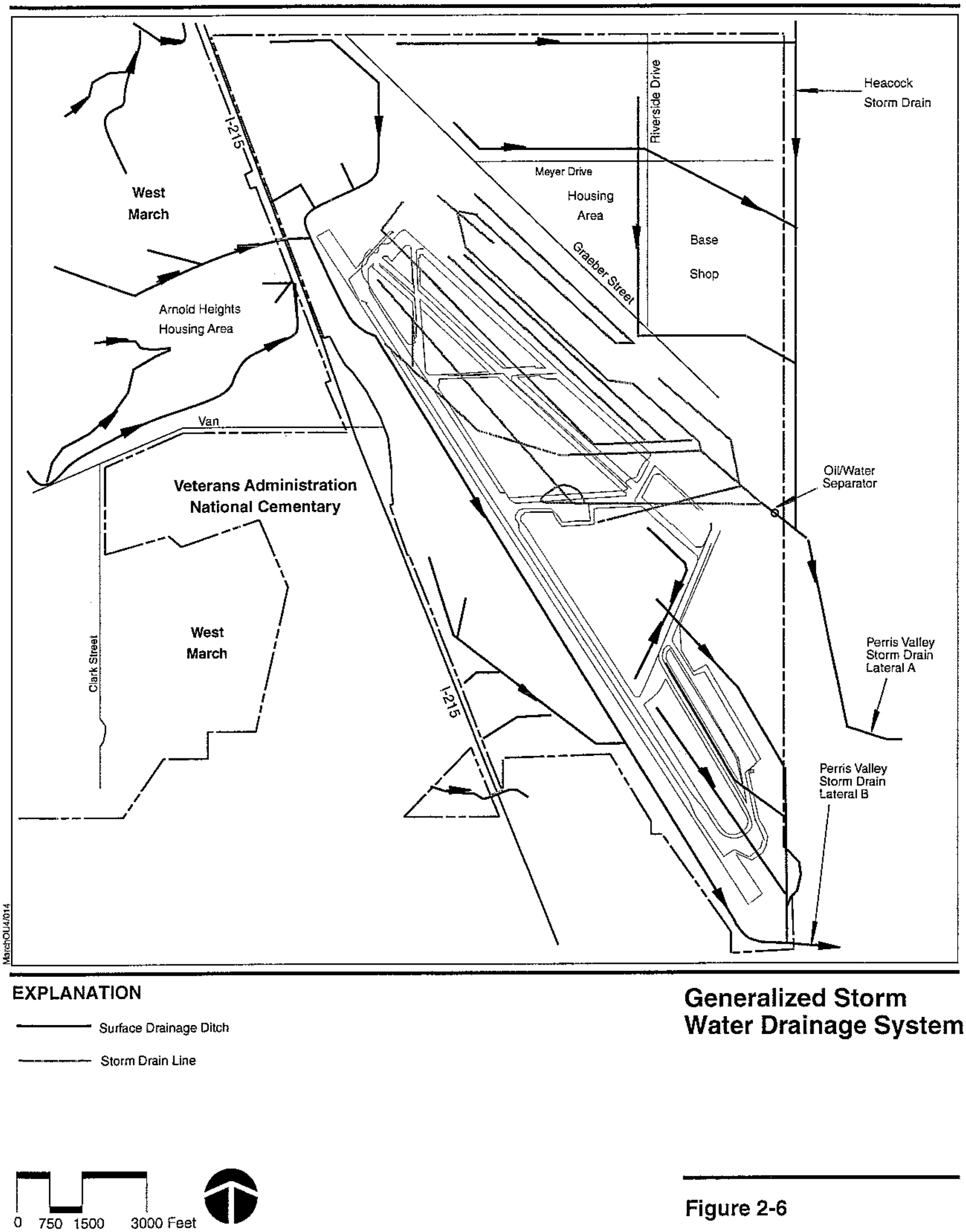
Figure 2-5

area of the base covered in this study lies within the San Jacinto watershed. The closest part of the Colorado River Aqueduct is approximately 1.5 miles south of March AFB/ARB adjacent to Site 21.

Streams near March AFB/ARB are ephemeral, flowing only when precipitation occurs. During short or light precipitation events, a large portion of the precipitation may infiltrate into the ground, reducing the amount of water available for surface runoff. However, during long or heavy precipitation events, the ground surface may become saturated, thereby reducing infiltration and increasing surface runoff. Standing water remaining after a storm event infiltrates or evaporates relatively quickly (Engineering Science, 1988).

Large portions of March AFB/ARB are covered with low permeability man-made features that reduce infiltration and increase surface runoff. In general, surface water runoff from March AFB/ARB is directed southeast through a series of storm drains and surface drainage ditches to the Perris Valley Storm Drain System east of the base. As shown in Figure 2-6, surface runoff from the West March area north of Arnold Heights generally flows north along I-215 to Alessandro Boulevard, where it is directed east to the Heacock Storm Drain. Surface runoff from the area around Arnold Heights is conducted through a series of surface ditches to a central drain near the intersection of Van Buren Boulevard and I-215 From here, the water is diverted under I-215 to the Main Base Once the water is east of I-215, it is channeled into a series of surface drainage ditches and directed south, then east, off-base through the Perris Valley Storm Drain Lateral B. Surface drainage ditches west of the main runway are typically unlined and drain the grassy and undeveloped dirt areas directing surface discharge to the south and east. Drainage of the flightline and southern part of the industrial complex is accomplished through a series of underground iron and concrete storm drains that connect to the oil/water separator before being discharged into the Perris Valley Storm Drain Lateral A The main cantonment area and part of the industrial area (northern part) is connected to the base's sewage treatment plant. The remaining area north and east of the flightline is drained by a series of surface drainage ditches that connect to the Heacock Storm Drain which flows south along the base's eastern perimeter until it connects with the Perris Valley Storm Drain Lateral A. Runoff in the Perris Valley Storm Drains (Laterals A and B) flows east, approximately 2 miles, where the laterals join, and together flow south another 6 miles to the San Jacinto River

Several surface water bodies can be found in and around March AFB/ARB. A recreational lake is located at the corner of Iris and Lasselle streets in Moreno Valley less than 2 miles north of the base. Two reservoirs, Mockingbird Canyon Reservoir and Lake Matthews, are located approximately 5 miles to the west of March AFB/ARB Lake Perris is 4 miles southeast of the base and provides approximately 130,000 acre-feet of storage for State Project Water brought in by the California Aqueduct that runs north and east of the base. An east-west portion of the Colorado River Aqueduct is located approximately 1.5 miles south of the base, adjacent to Site 21. This aqueduct flows into Lake Matthews. Surface water quality records have not been collected at U.S. Geological Survey (USGS) gauging stations along the San Jacinto River near March AFB/ARB.



Generalized Storm Water Drainage System

Figure 2-6

However, samples have been collected at a USGS gauging station for the Santa Ana River at the Metropolitan Water District Crossing near Arlington, California (USGS station number 11066460), northeast of March AFB/ARB. Between 1985 and 1986, the temperature of the Santa Ana River at this station varied between 14 °C in the winter and 29.5 °C in the summer During that same period, the suspended solid concentration at the station ranged from 274 ppm to 697 ppm, although no seasonal patterns were evident Specific conductivity at this station has ranged from a minimum of 95 microsiemens in 1970, to a maximum of 1,320 microsiemens in 1969 (Bowers et al., 1985, 1986).

2.5 CLIMATOLOGY/METEOROLOGY

The following section presents the climatologic and meteorologic conditions found at March AFB/ARB.

Climate. The climate of the March AFB/ARB area is characterized as Mediterranean to semi-arid. The climate in the region varies according to elevation and distance from the Pacific Ocean. The weather generally consists of warm to hot dry summers and mild winters (Ruffner, 1978; Engineering Science, 1988). A summary of meteorologic data collected between 1936 and 1989 for March AFB/ARB is presented in Table 2-1

Winter storms, summer storms, and high intensity, short duration thunderstorms can occur in the area Winter storms generally last for a period of several days. Summer storms, although rare, occur occasionally in the area. Thunderstorms can occur at any time during the year but are most common from July to September (RCFCWCD, 1978).

Mean annual precipitation for mountainous regions near the base is as much as 40 inches per year and occur in the form of snow and rainfall. Mean annual precipitation for regions of lower elevation near the base range from approximately 9 to 13 inches and generally occurs as rainfall (Ruffner, 1978; RCFCWCD, 1978; and Engineering Science, 1988).

Precipitation records for March AFB/ARB indicate that between February 1936 and July 1989, the mean annual precipitation was 9.93 inches. The maximum and minimum annual precipitation for that period was 23.96 inches and 3.38 inches, respectively. The greatest monthly precipitation was 8.89 inches that occurred in February 1969. Most precipitation occurs during the winter season, from November to April. During periods when temperatures drop below freezing, light snowfall can occur at the base. The maximum snowfall occurring in 24 hours was 3.09 inches

Approximately 67 percent of the evaporation near March AFB/ARB occurs between May and October. According to U.S. Weather Bureau maps, the average annual Class A pan evaporation near March AFB/ARB is approximately 80 inches per year (Chow, 1964). Average pan evaporation for the San Jacinto Basin is about 84 inches per year (Engineering Science, 1988).

Table 2-1. Climatological Data for March AFB/ARB (February 1936 - July 1989)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	YOR
Extreme Max Temp (F)	85	87	95	100	108	110	110	111	114	110	94	90	114	53
Mean Max Temp (F)	62.7	64.5	66.2	71.9	76.9	84.2	92.5	92.0	88.1	79.5	70.8	64.7	76.2	53
Mean Temp (F)	50.9	52.7	54.4	58.9	63.9	69.8	76.9	76.8	73.3	65.4	57.4	52.3	62.8	53
Mean Min Temp (F)	38.9	40.6	42.3	45.7	50.6	55.1	60.9	61.4	58.2	51.0	43.7	39.6	49.0	53
Extreme Min Temp (F)	16	22	24	27	32	39	48	47	42	28	26	17	16	53
D/W Temp GE 100 (F)	0	0	0	#	1	1	4	4	3	1	0	0	14	53
D/W Temp GE 90 (F)	0	0	#	1	3	9	22	21	14	5	1	#	76	53
D/W Temp LT 40 (F)	16	12	9	4	1	#	0	0	0	1	7	15	65	53
D/W Temp LT 33 (F)	5	2	1	1	#	0	0	0	0	#	1	4	14	53
Heating Degree Days	417	336	319	193	87	18	#	#	5	65	226	382	2048	53
Cooling Degree Days	#	1	2	20	62	170	375	377	263	88	9	1	1368	53
Mean Dewpoint Temp (F)	35.1	38.2	41.4	43.3	48.4	51.9	55.0	55.7	54.1	47.3	38.1	34.4	45.3	10
Mean Wet Bulb Temp (F)	44.7	46.6	48.3	51.5	55.3	59.5	63.5	63.8	61.6	55.6	47.9	44.1	53.6	10
99.95% WCPA (Ft)	1750	1750	1800	1700	1700	1700	1700	1700	1750	1700	1700	1750	1750	10
Mean Rel Hum 07 LST (%)	70.3	73.7	78.8	72.3	73.6	64.6	69.6	67.2	70.6	72.8	68.8	68.2	70.9	10
Mean Rel Hum 13 LST (%)	42.2	42.7	46.4	39.5	40.0	30.8	36.2	32.5	35.2	36.2	37.1	39.0	38.1	10
Max 24 Hr Precip (In)	3.09	2.42	2.42	1.57	1.08	1.38	.25	1.74	2.08	1.06	2.10	2.68	3.09	53
Max Precip (In)	6.27	8.89	6.09	4.57	2.07	1.46	.28	2.39	3.01	2.92	5.55	6.06	23.96	53
Mean Precip (In)	1.92	1.87	1.64	.83	.18	.08	.08	.17	.31	.37	.98	1.54	9.93	53
Min Precip (In)	.00	.00	.00	#	#	.00	.00	.00	.00	.00	.00	#	3.38	53
D/W Precip GE .01 (In)	6	5	6	4	1	1	1	1	1	2	3	5	36	53
D/W Precip GT .50 (In)	1	1	1	1	#	0	0	#	1	1	1	1	8	53
Max 24 Hr. SNFL (In)	3.0	.2	.6	0	0	0	0	0	0	0	.1	.8	3.0	43
Max SNFL (In)	4.9	.2	.6	0	0	0	0	0	0	0	.1	1.1	4.9	43
Mean SNFL (In)	.1	0	#	0	0	0	0	0	0	0	0	#	.2	43
D/W SNFL GE .1 (In)	#	#	#	0	0	0	0	0	0	0	#	#	0	43
D/W SNFL GE 1.5 (In)		0	0	0	0	0	0	0	0	0	0	0	0	43
Max Dly Sno Depth (In)	2	0	#	0	0	0	0	0	0	0	0	1	2	43
Mean SFC Wnd Dir (Deg)	330	300	300	300	300	300	300	300	300	300	300	330	300	10
Mean Wnd SPD (KTS)	3.3	3.2	3.2	3.8	3.9	4.1	3.8	3.5	3.0	2.7	2.9	2.9	3.4	10
Max Wnd SPD (KTS)	46	45	48	40	38	39	43	36	39	41	44	49	49	42
Sky Cover GT ½ (%)	41.0	48.4	46.0	43.3	42.0	28.9	17.0	19.7	27.0	35.6	37.0	39.3	35.7	10
D/W Thunderstorms	1	1	1	1	1	1	1	1	1	1	1	1	12	40
D/W Fog (Vsby LT 7 Mi)	13	14	18	15	17	16	10	10	13	16	13	12	167	40

Key:

Ann	=	Annual	YOR	=	Period/Years of Record
D/W	=	Mean Number of Days With	WCPA	=	Worst Case Maximum Pressure Altitude
&	=	Based on Less Than Full Months	#	=	Less than 0.5 Days or Trace as Applicable
‖	=	Instantaneous Peak Winds	SNFL	=	Snowfall
*	=	Data Not Available	KTS	=	Knots
GE	=	Greater Than or Equal To	LT	=	Less Than

Source: March Air Force Base Ninth Weather Squadron, 1991

Temperatures near March AFB/ARB have varied from an extreme low of 16 °F to an extreme high of 114 °F (Ruffner, 1978; Engineering Science, 1988). Temperature records for March AFB/ARB indicate that between 1936 and 1989, the mean maximum temperature for July was 92.5 °F and the mean minimum temperature for January was 38.9 °F. The highest temperatures generally occur in July and August and the lowest temperatures generally occur in December and January. On an annual average, the base experiences approximately 14 days with temperatures below freezing and 14 days with temperatures in excess of 100 °F.

Wind. The prevailing wind at March AFB/ARB is from the northwest with an average wind speed of 4 knots. The dry, strong Santa Ana winds, which can travel at speeds greater than 30 knots, generally occur between October and March and can last for several days (Ruffner, 1978; CH2M Hill, 1984).

Air Quality. The potential for air pollution in the March AFB/ARB area is relatively high (Tetra Tech, 1997b). Of the five air pollution constituent's monitored (carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone, and total suspended particulates), ozone poses the most significant problem. Based on relative percent frequency of combined Pasquill Stability Categories, the air quality varies seasonally (Tetra Tech, 1997b). Air quality also varies diurnally. The poorest air quality occurs during spring and summer months (Tetra Tech, 1997b).

2.6 BIOLOGY AND ECOLOGY

The following section presents the ecological and biological setting found at March AFB/ARB.

Ecological Setting. March AFB/ARB is located within the California biotic province. The California biotic province includes vegetation types, flora, fauna, climate, physiography, and soils found in California west of the Sierra Nevada and in the southern mountains and valleys. It includes the coast range of San Francisco Bay and the interior valleys and hills in the central and northern parts of the state (Munz, 1968). Native vegetation at the base originated from the valley grassland and coastal sage plant groups. Hilly areas near March AFB/ARB are covered by California sagebrush, white sage, California buckwheat, brittle brush, and perennial or annual forbs. A few willow and juniper trees are found in the area. The ecological conditions existing at March AFB/ARB can be classified into the following categories:

- 45 percent unimproved, semi-natural areas
- 13 percent improved or grassed areas
- 24 percent maintained for erosion, dust, or visual clear zone control
- 18 percent buildings, runways, or otherwise covered.

Approximately 24 percent of the land near March AFB/ARB is leased for grazing or agricultural use. Vegetation from the valley grassland plant group covers the valley areas where the Main Base, runways, and highways are now located. Non-native grasses and weedy species have generally replaced native bunch grasses that used to grow in the area. Ornamental trees including palm, pine, eucalyptus, cottonwood, and pepper have been planted in developed areas of the base (U.S. Air Force, 1991). Members of the native bunch grass plant community, which is increasingly rare in southern California, grow in the grassland area between Runway 14-32 and I-215 and along the west side of Plummer Road on West March.

Although Southern Coast Live Oak Riparian Forest and Southern Sycamore Alder Riparian Woodland plant communities, considered sensitive by the state of California, potentially occur in the March AFB/ARB area, they are not found on the base.

A number of wetlands and riparian areas have been identified on and in the immediate area of the base. Most are located on West March. The U.S. Army Corps of Engineers (USACE) has performed a delineation of jurisdictional wetlands associated with the Heacock and Cactus flood control channels (USACE, 1992). Although these are artificial channels excavated in uplands, they act as ephemeral streams, support some wetland vegetation, and are considered waters-of-the-United States. The USACE determined that approximately 3.8 acres of jurisdictional wetlands and 10.1 acres of "waters of the United States" exist in the Heacock and Cactus Channels.

Wildlife. Limited populations of aquatic wildlife exist in wetlands associated with drainage channels and man-made ponds and reservoirs on the base. There are no major ephemeral and no perennial streams near the base that could support other aquatic life (U.S. Air Force, 1991).

Audubon cottontail, San Diego black tailed jackrabbit, coyote, red fox, California ground squirrel and other rodents live on the unimproved lands at March AFB/ARB. Feral dogs are common in the West March area. A large population of ground squirrels supports numerous burrowing owls in the hills of the West March area. Burrowing owls also have been observed near the base hospital and in open areas in the east and south areas of the Main Base.

More than 90 bird species are known to exist near the base, including American kestrel, barn owl, white-tailed kite, and red-tailed and ferruginous hawks. Other raptors that may occur on the base are the black-shouldered kite, northern harrier, merlin, prairie falcon, and golden eagle. Several species of songbirds, quail, dove, ravens, starlings, and pigeons exist near the buildings on the Main Base (CH2M Hill, 1984).

Threatened or Endangered Species. A number of federally-listed threatened, endangered, or candidate plant and animal species are likely to occur on March AFB/ARB. A federally-listed species, which is provided protection under the Endangered Species Act (ESA), is so designated because of threatened extinction as a consequence of economic growth and development without adequate concern and conservation. A Category 1 candidate is a species about which sufficient information exists to support its being listed as threatened or endangered, but the proposed rules for listing have not yet been issued. A Category 2 candidate is a species that is under consideration for listing as threatened or endangered, but about which not enough information is known to merit listing. Table 2-2 lists the state and federally-listed plant and animal species known to occur or potentially to be occurring in the vicinity of March AFB/ARB.

Table 2-2. Federal and State Listed Sensitive Species at March AFB/ARB

(Some Federal Category 2 candidate species that are not State listed have been omitted.)

Scientific Name	Common Name	Federal Status*	State Status*	Other
Flora				
Allium fimbriatum var. munzi	Munz's Onion	C1	T	
Brodiaea filifolia	Thread-leaf Brodiaea	C1	SE	
Caulanthus simulans	Payson's Jewelflower	C2	-	
Dudleya multicaulis	Many-stemed Dudleya	C2	-	
Eryngium aristulatum var. parishii	San Diego Button Celery	PE	SE	
Myosurus minimus	Little Mouse-tail	C2	-	
Orcuttia californica	California Orcutt Grass	PE	SE	
Ribes canthariforme	Moreno Currant	C2	-	
Mammals				
Dipodomys stephensi	Stephens' kangaroo rat	FE	SE	
Lepus californicus bennetti	San Diego black-tailed jackrabbit	C2	CSC	
Perognathus longimembris brevinasus	Los Angeles little pocket mouse	C2	CSC	
Reptiles				
Cnemidophorus hyperythrus	Orange-throated whiptail	C2	CSC	
Cnemidophorus tigris multiscutatus	Coastal western whiptail	C2		
Crotalus ruber ruber	Northern red diamond rattlesnake	C2	CSC	
Phrynosma coronatum blainvillei	San Diego horned lizard	C2	CSC	
Birds				
Accipter cooperii	Cooper's hawk		CSC	
Aquila chrysaetos	Golden eagle		CSC, CFP	
Athene cunicularia	Burrowing owl		CSC	
Buteo jamaicensis	Red-tailed hawk			LC
Buteo lineatus	Red-shouldered hawk			LC
Buteo regalis	Ferruginous hawk	C2	CSC	
Circus cyaneus	Northern harrier		CSC	
Eremophila alpestric actia	California horned lark	C2	CSC	
Falco mexicanus	Prairie falcon		CSC	
Lanius ludovicianus	Loggerhead shrike	C2	CSC	
Vireo bellii pusillus	Least Bell's Vireo	FE	SE	

FE = Federally-Endangered
SE = State-Endangered
C2 = Federal Category 2 Candidate
CSC = California Species of Special Concern
CFP = California Fully Protected
LC = Local Concern
T = Threatened
PE = Proposed Endangered

Source: U.S. Fish and Wildlife Service Letter, 5/15/92; California Department of Fish and Game, 1992; Tetra Tech, July 1997b

The Stephens' kangaroo rat (SKR), a federally-listed endangered and state-listed threatened species, is endemic to the Perris and San Jacinto valleys of western Riverside County. Western Riverside County, of which March AFB/ARB is a part, is one of the most rapidly developing areas in the United States The conversion of habitat to agricultural lands and urbanization has resulted in the loss of over three-fourths of this species' habitat. The fragmentation of the remainder of the available habitat has posed immediate threats to the existence of the species, particularly in the smaller and more isolated fragments.

The SKR is generally found in grasslands and herb lands along the edges of coastal and inland sage scrub, and almost always occupies habitats in which at least half of the soil is bare during the summer and fall. Filaree (a low-lying flowering weed) frequently dominates the best habitat. The soil type is an important factor in habitat utilization — a correlation with the burrowing and foraging behavior of this species.

A survey of March AFB/ARB was conducted by the United States Fish and Wildlife Service (USFWS) in the summer of 1989 (USFWS, 1989) for the SKR. The SKR habitat on the base was found to be unevenly distributed, which is typical throughout the range of the rodent. Although the soil types are gravelly and the herbaceous layer is dominated by filaree on March AFB/ARB, much of the grassland of the base is believed to be too solid to support uniform densities of the rodent; however, their presence was noted in other small, open areas. There are two relatively large areas of uniformly dense habitat on West March. Most of West March was mapped as low-density occupancy by the SKR. A recent SKR survey (December 2000) identified SKR signs and one animal on March ARB land just west of the main runway.

No other threatened or endangered mammals have been identified as potentially present in the area of March AFB/ARB However, two Federal Category 2 species have been identified on March AFB/ARB: San Diego Black-tailed Jackrabbit and Los Angeles Little Pocket Mouse. Both have been identified on West March (U S. Air Force, 1991; Tetra Tech, 1993), and the Black-tailed Jackrabbit has been identified in OU1. In addition, a small population of burrowing owl (*Athene cunicularia*), a state bird of special concern, is known to exist on the March flightline.

3.0 STUDY AREA INVESTIGATION

3.1 FIELD ACTIVITIES AND SITE CHARACTERIZATION

This section summarizes the field activities performed at each site under the OU4 RI. IRP Sites investigated as part of this RI include Sites 21, 41, and 44, and non-IRP Site L, Water Tank 3401, Water Tank 6601, and the mercury investigation at the former Base Hospital and Dental Clinic. Table 3-1 summarizes the sampling activities performed at each of the OU4 sites Field activities included the collection of surface and near-surface soil samples, shallow hand-auger borings, continuous core soil borings, and depth-discrete groundwater samples collected during drilling

Table 3-1. OU4 RI Field Activities

	Number of Primary Sample Locations				
Site	Discrete Water Screening Samples	Hand Boring Samples	Surface Soil Samples	Sludge/ Sediment Samples	Indoor Ambient Air Samples
21	6	20	--	--	--
41*	--	--	--	--	--
44*	--	--	--	--	--
Site L*	--	--	--	--	--
Water Tower 3410	--	--	3	--	--
Water Tank 6601	--	6	--	--	--
Base Hospital/Dental Clinic	--	2	--	27	12
Total	**6**	**28**	**3**	**27**	**12**

Note: * Indicates sites investigated and remediated by other contractors

Field investigations were conducted by others at Sites 41, 44, and Site L but are summarized in this Focused OU4 RI report to complete the documentation of the investigations and actions performed. Site 41 included a geophysical investigation to identify subsurface structures and potential disposal areas. In addition, an asbestos and lead-based paint survey was conducted, and the contaminated materials were removed and properly disposed. Throughout the entire field investigation, tortoise monitoring was conducted to ensure that field activities did not disturb the protected desert tortoise. Tetra Tech, Inc., completed site investigative work at Site 41, and underground storage tanks were removed and the excavations backfilled by CKY, Inc. Mercury-contaminated soil at IRP Site 44 and at Water Tank 6601 were excavated, disposed, and the excavations backfilled by IT Corporation. Soil sampling, soil excavation, backfilling of the excavation, and installation of the asphalt cap at Site L was accomplished by Tetra Tech, Inc. The following sections provide details about the field activities completed and the current risk associated with each site.

3.1.1 Analysis of background samples

Soils contain inorganic chemicals of natural origin as well as potential organic chemicals derived from regional airborne emissions or other anthropogenic sources. The determination of hazardous chemicals in soil and groundwater for a particular site was made by comparing analytical results from each site location with those from a known set of background samples OU4 sites are situated in both the West March and Main Base areas. Because geological and geochemical differences have been demonstrated between the Main Base and West March, this OU4 investigation will use inorganic data from the OU2 investigation to determine whether a particular inorganic compound is a site contaminant or not.

3.1.2 Background soil sampling

The analysis of background concentrations for OU2 was complicated since OU2 sites were located in both the West March area and on the Main Base The background study for OU2 included a review of data from the OU1 investigation and collection of samples from West March and the northwestern portion of the Main Base because of the geologically different terrain between the two areas. Since OU4 sites are located in both West March and in areas geologically similar to the main base, background values for inorganics at the majority of the OU4 sites used OU2 background values. Twelve background surface samples and one replicate were collected in April 1993 from seven West March and five Main Base locations These locations were selected to represent naturally occurring soil conditions at March AFB. In June and July of 1993, ten boreholes were drilled and sampled, two at West March and eight Main Base locations. A total of 14 samples plus replicates were collected from West March and 45 samples plus replicates were collected from the Main Base. Some correlations made during the OU2 investigation were that certain metals varied in concentrations from the Main Base to West March. Metals concentrations appear to be higher in the finer-grained sediments. In general, the soils on West March have higher concentrations of barium, beryllium, chromium, cobalt, copper, molybdenum, vanadium, and zinc, whereas, Main Base soils have higher mean concentrations of arsenic, boron, cadmium, lead, nickel, and selenium. Table 3-2 summarizes the background values for all metals observed in soil at March AFB (Main Base and West March values). Table 3-3 summarizes the maximum background values for all metals observed in and at March AFB.

Both the OU1 and OU2 investigations showed detectable, but low concentrations of chlorinated pesticides (DDT, DDE, DDD, endrin, and chlordane) and chlorinated herbicide MCPA The presence of pesticides and herbicides are likely the result of the proper application of these commercial products Since pesticides have been widely used in the surrounding agricultural areas and at the base, these compounds were not considered to be unauthorized releases. Similarly, polynuclear aromatic hydrocarbons (PAHs) are products of combustion (e.g , automobile exhaust) that are ubiquitous in urban areas and within agricultural soils (Agency for Toxic Substances and Disease Registry 1993). All organic compounds detected in soil were assumed to be elevated above background concentrations.

Table 3-2. Mean Background Comparisons of Inorganic Compounds, March ARB/AFB, Riverside, California

Inorganic Compound	OU2 Main Base (Mean Concentration in mg/kg)		OU2 West March (Mean Concentration in mg/kg)		Residential PRG (October 2002)
	Surface	All depths	Surface	All depths	
Aluminum	9,040	9,140	12,200	13,000	76,000
Arsenic	3.24	3.33	1.57	1.23	0.39 (cancer endpoint)
Barium	121	123	217	271	5400
Beryllium	0.690	0.676		2.56	150
Boron	4.8	4.84	4.48	3.97	16,000
Cadmium	0.715	0.674			37
Calcium	2,190	2,620	2,390	2,750	NS
Chromium	12.1	10.1	18.2	17.3	210 (total)
Cobalt	8.10	7.45	12.8	12.2	900
Copper	10.5	8.65	12.3	9.91	3,100
Iron	14,600	15,200	20,600	21,000	23,000
Lead	12.9	5.68	8.05	4.55	150 (Cal Modified)
Magnesium	3,780	3,960	5,900	6,400	NS
Manganese	331	325	373	311	1,800
Mercury	0.0214	0.0259	0.0186	0.0195	23 (Hg + compounds)
Molybdenum	1.22	0.859	--	2.61	390
Nickel	6.48	6.56	8.51	8.39	1,600
Potassium	4,030	4,010	6,150	6,310	NS
Selenium	--	5.93	--	--	390
Silver	--	--	--	--	390
Sodium	90.9	178	150	267	NS
Thallium	--	--	--	--	5.2
Vanadium	29.3	30.1	46.5	48.1	550
Zinc	40.6	43.1	81.0	58.9	23,000

Table 3-3. Maximum Background Comparisons of Inorganic Compounds, March ARB/AFB, Riverside, California

Inorganic Compound	OU2 Main Base (Maximum Concentration in mg/kg)		OU2 West March (Maximum Concentration in mg/kg)		Residential PRG (October 2002)
	Surface	All depth	Surface	All Depths	
Aluminum	13,300	21,300	20,100	27,900	76,000
Arsenic	6.0	6.5	4.52	5.26	0.39 (cancer endpoint)
Barium	260	916	371	552	5400
Beryllium	1.115	1.285		10.95	150
Boron	5.63	9.53	3.24	6.02	16,000
Cadmium	1.115	1.285			37
Calcium	3,460	16,500	2,870	4,780	NS
Chromium	19.5	21.0	29.1	29.1	210 (total)
Cobalt	13.1	16.0	16.1	16.1	900
Copper	13.3	16.1	17.0	17.0	3,100
Iron	22,100	31,700	30,100	31,000	23,000
Lead	40.7	40.7	17.2	17.2	150 (Cal Modified)
Magnesium	6,260	7,660	7,960	9,940	NS
Manganese	467	736	561	561	1,800
Mercury	0.0616	0.0622	0.0543	0.0772	23 (Hg + compounds)
Molybdenum	3.125	3.125		11.2	390
Nickel	8.95	10.25	10.4	10.4	1,600
Potassium	7,030	8,750	9,090	9,630	NS
Selenium		12.5			390
Silver					390
Sodium	198	571	360	880	NS
Thallium					5.2
Vanadium	43.6	62.8	70.1	75.4	550
Zinc	55.7	512	65.2	65.2	23,000

mg/kg = milligrams per kilogram
OU = operable unit
PRG = USEPA Region IX Preliminary Remediation Goal
UTL = upper tolerance limit

3.2 SITE 21

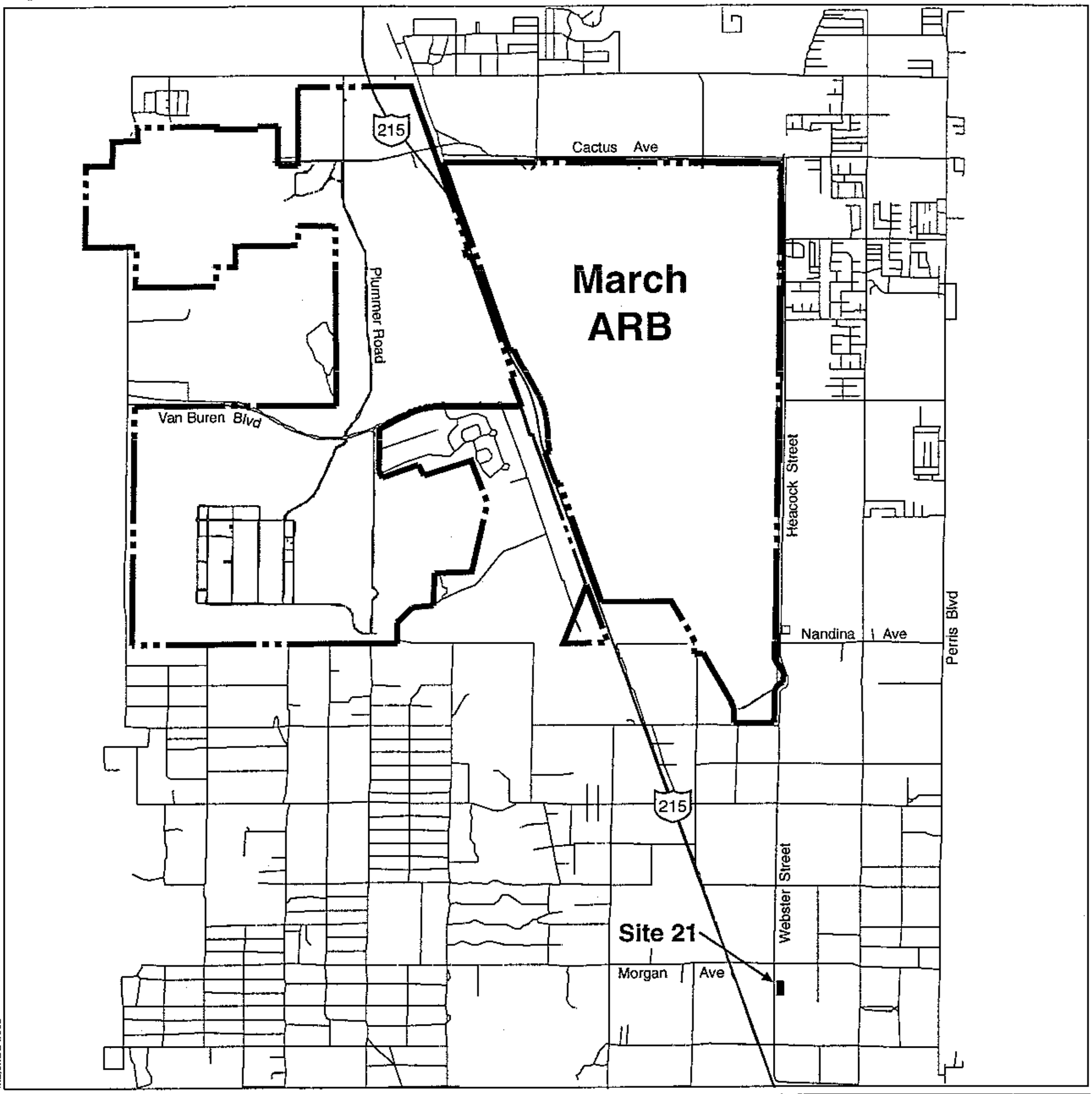
3.2.1 Site Background

Site 21 is the Cordures effluent pond. The site is located off base, approximately 1.5 miles south of the southeast corner of the former base boundary, approximately 600 feet southeast of the corner of Morgan Avenue and Webster Street in the city of Perris (east side of Webster Street) (Figure 3-1). The effluent pond was used from 1941 to 1946 and again from 1955 to 1984 to hold treated wastewater from the base Sanitary and industrial wastewater received primary and secondary treatment at the base prior to discharge into this holding pond. The treated effluent was held in the pond and used for irrigation of the surrounding agricultural land. The boundaries of the effluent pond were physically well defined by a berm during the 1993 OU1 RI/FS. At that time, the site covered an area of approximately 2.2 acres and was being used by private parties as an illegal dump. About 1998, the berm was removed and the site was incorporated into the surrounding sod farm. About 2001, the land was sold and the site is currently part of a Ross warehouse distribution facility The area of the former pond consists of a landscaped berm on the west and a truck parking area that lies approximately 8 feet below grade on the east. Based on historic use, the primary contaminants of concern at Site 21 included metals, VOCs, and pesticides.

3.2.1.1 Previous Investigations.

The Phase II, Stage I investigation consisted of three 10-foot hand-auger borings and the collection and analysis of six subsurface soil samples. Soil samples were analyzed for oil and grease, volatile halogenated organics, volatile aromatic organics, phenols, and heavy metals. Oil and grease were the only organic compounds detected during the Stage 1 investigation. None of the analytes detected exceeded regulatory standards, guidelines, or background levels as identified by Engineering Science (1988). During the OU1 RI/FS, additional compounds were detected during the investigation The following organic compounds were detected in the soil during the OU1 RI/FS: acetone, bis(2-ethylhexyl)phthalate, phenol, dichlorodiphenyldichloroethane, dichlorodiphenyldichloroethylene, and PCB-1254. These organic compounds were detected at very low concentrations; however, these concentrations were above background levels. SVOCs were only detected in one of 31 surface soil samples collected. Additional sampling for SVOCs was not warranted. Low concentrations of several metals were also detected above background levels.

During the OU1 RI investigation, groundwater was also sampled. A groundwater monitoring well (21MW1) was installed at the downgradient end of the site. Sample results indicated that the only VOCs detected in groundwater were toluene and xylenes, and the only SVOC detected was phenol. These organic compounds were detected above background levels, although at very low concentrations. Several metals were also detected at low concentrations but above background levels.



EXPLANATION

Base Boundary

Site 21 Location Map

Figure 3-1

3.2.1.2 Previous Recommendations.

At the conclusion of the Stage 1 investigation, a NFADD was prepared and submitted to EPA.

Data collected during the OU1 investigation were not included in the Final OU1 RI/FS because Site 21 was transferred to OU2 in 1994, before the OU1 RI/FS was completed. Site 21 was again transferred from OU2 to OU4 prior to completion of the OU2 investigation.

3.2.2 OU4 RI Investigation

The following sections detail OU4 objectives, review OU4 field activities, describe variations from the Work Plan, and summarize laboratory methods

3.2.2.1 OU4 Objectives.

The primary objective of the Site 21 field investigation was to confirm the presence of contamination and assess the lateral and vertical extent of soil and groundwater contamination, if present, at the site resulting from past uses, i.e., storage of treated wastewater from March AFB. A second objective was to determine the direction of groundwater flow beneath the site and the potential for off-site migration of groundwater contaminants, if they exist. The RI investigation conducted at Site 21 was in accordance with the Basewide RI/FS Work Plan prepared by Earth Tech (1998).

3.2.2.2 Review of Field Activities.

Based on a preliminary site walk completed under the OU4 investigation in October 1997, the site had been graded and the bermed areas removed. Household trash, refrigerators, green waste and miscellaneous debris that was observed during the OU1 investigation had also been cleaned up. Approximately 2 to 3 feet of fill (possibly from the berm) was placed on top of the original ground surface The site appeared to be level with the adjacent areas and was unfenced and unrestricted to the public. No hazardous waste signs were posted on the site.

Near-surface soil samples were collected from hand-auger borings located within the area of the former effluent pond at Site 21. Soil samples were collected from a 40-foot by 40-foot grid across the former pond location. Samples were taken from 3 to 4 feet bgs in an attempt to collect soil from the surface of the former pond. A total of 20 samples were collected plus two duplicates. A large amount of grass clippings were noted on the ground surface at sample locations 03, 04, 07, 08, and 12. Although the ground surface was cleared of grass cuttings prior to soil sampling activities, it was noted that these cuttings could be a potential source of pesticides in the samples.

Two groundwater monitoring wells were proposed for the site (21MW2 and 21MW3). The intent was to collect lithologic data using continuous cores and then collect depth-discrete groundwater samples from all water-bearing zones during drilling. A total of three depth-discrete groundwater samples were collected from borehole 21MW2 at 146 to 162 feet, at 171 to 183 feet, and from 201 to 205 feet bgs A total of three depth-discrete groundwater samples were collected from 21MW3 at 146 to 158 feet, at 176 to 186 feet, and from 186 to 205 feet bgs. Prior to collecting the depth-discrete groundwater samples from the boreholes, a minimum of two borehole volumes of water were purged to collect samples that were as representative as possible of the in-situ aquifer conditions. Based on the analytical results from these depth-discrete samples, the Air Force and regulators agreed that no new groundwater monitoring wells were needed at the site. The boreholes were grouted to the surface.

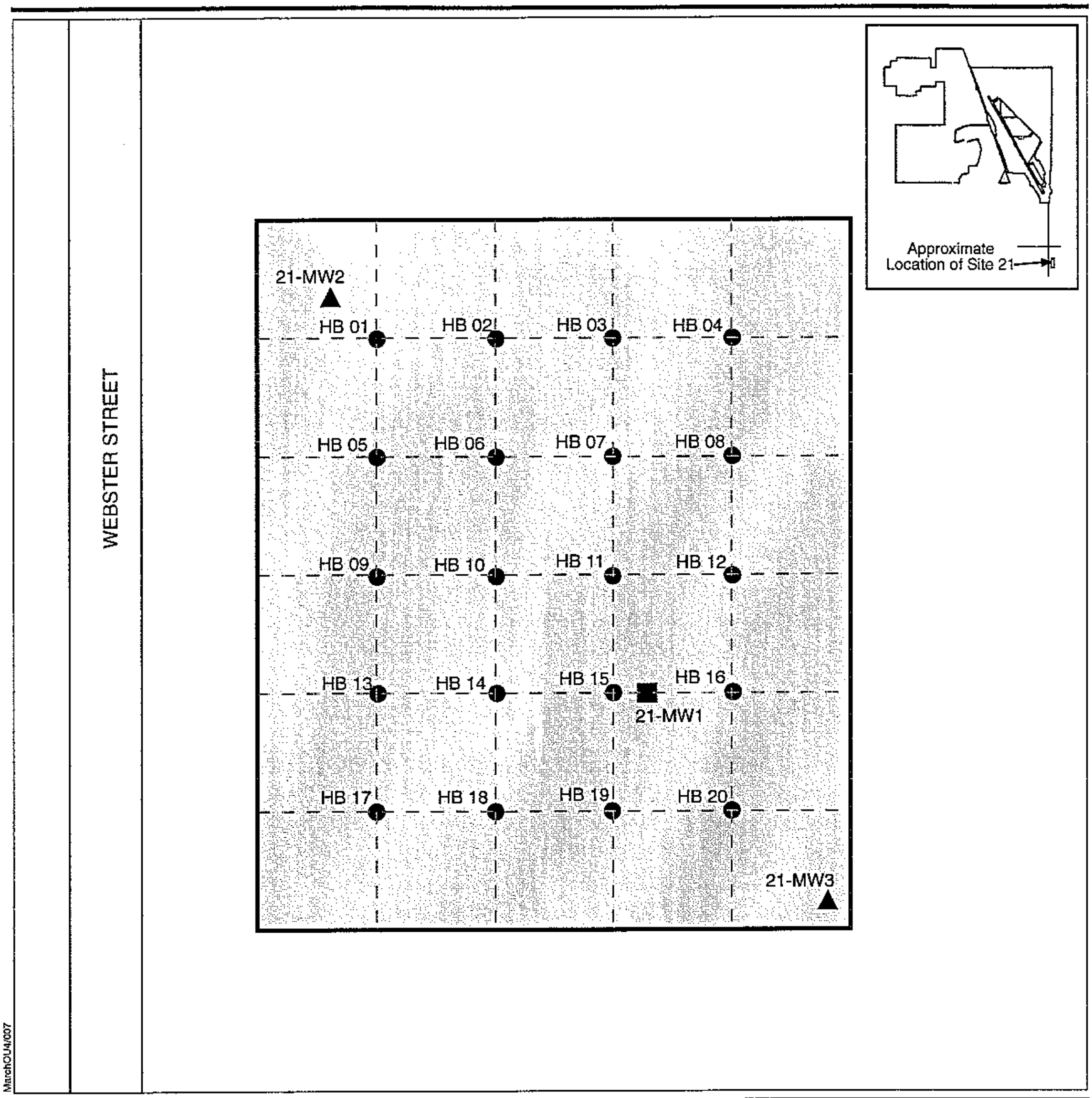
3.2.2.3 Variations from the Work Plan.

Surface soil sampling locations were originally based on a 40-foot by 40-foot grid with subsurface soil samples to be collected at each node Because no particular contaminant trend could be identified from the OU1 investigation, and because the site was graded over (possibly displacing surface soils), the surface-soil sampling grid was modified to cover the entire former pond area. Based on data from the OU1 RI, a total of 36 surface soil samples plus associated quality control samples was determined to be sufficient to characterize surface soils at the site. These 36 surface soil samples were overlaid on a grid system that characterized the entire former pond area. Prior to the collection of the surface and near-surface samples, a 40-foot by 40-foot grid spacing was established over the 200-foot by 240-foot former pond area. Consequently, only 20 samples were required to completely cover the former pond area A total of 20 samples (plus QA samples) were collected at the nodes of the 200-foot by 240-foot grid set on a 40-foot spacing (Figure 3-2).

During drilling of the two groundwater monitoring well boreholes, depth discrete groundwater samples were collected. These screening-level groundwater samples were analyzed for VOCs by EPA Method SW8260B, pesticides by EPA Method SW8081A, PCBs by Method SW8082, metals by EPA Method SW6010B, and general minerals. General minerals included alkalinity, hardness, chloride and sulfate, methylene blue active substances, and TDS. Both the lithologic data and the screening level groundwater sample results were used to identify zones of high transmissivity and elevated contaminant levels. As originally scoped, these two boreholes were to be converted to monitoring wells at a later date. However, since no contamination was found in the groundwater or soil samples, monitoring wells were not installed. The boreholes were grouted at the completion of sampling.

3.2.2.4 Summary of Laboratory Methods.

Near-surface soil samples collected from hand-auger borings within the former footprint of the pond were analyzed for metals using EPA Method SW6010B, pesticides using EPA Method SW 8081A, PCBs using EPA Method SW 8082, VOCs using EPA Method SW8260B, and SVOCs using EPA Method 8270C No subsurface soil samples were collected for laboratory analysis from the two continuously cored boreholes (21MW2 and 21MW3)



EXPLANATION

- ■ Existing Stage 5 Monitoring Well Location
- ▲ Completed Monitoring Well Borehole Location
- ● Shallow Boring (Surface Soil) Sample Locations

Site 21
Shallow Soil Boring
Monitoring Well

Figure 3-2

Depth-discrete groundwater samples were collected during drilling from the two proposed monitoring wells (21MW2 and 21MW3) These depth-discrete groundwater samples were analyzed for VOCs using EPA Method 8260B, pesticides using EPA Method SW8081A, PCBs using EPA Method SW8082, metals using EPA Method SW6010B and general minerals. Depth-discrete groundwater samples indicated that no contamination was present in the groundwater beneath the site, and the Air Force and regulators agreed not to install additional groundwater monitoring wells.

3.2.3 Physical Site Conditions

3.2.3.1 Surface Features.

Site 21 and the surrounding area is part of the Perris Valley floor, with a relatively gentle slope to the east of approximately 30 to 40 feet per mile (USGS Perris 7 ½ minute quadrangle, 1967a). Prior to the initial phase of the OU4 investigation, the berm that was present during the OU1 investigation had been removed, the site had been leveled, and the area was being used as a commercial sod farm The sod farm was irrigated with reclaimed water from the Moreno Valley Wastewater Treatment Plant. During a site visit in June 2003, it was observed that the site is now part of a landscaped berm and subgrade paved parking area for warehousing trucks for the Ross Department Stores Warehouse Distribution facility that currently occupies the site and adjacent land.

3.2.3.2 Stratigraphy.

Site 21 surface soils consist predominantly of fine-grained silty sand and sandy silt with some clay During the collection of hand-auger samples, it was noted that the soil had been disturbed to a depth of 2 to 3 feet as a result of the grading that had taken place to remove the berm and to grade the area flat Two continuous borings drilled as part of the groundwater investigation showed that from the surface to 200 feet bgs, the soil was dominated by alternating layers of silty sand and sandy silt. Occasional thin lenses of poorly graded to well graded sands from 1 to 6 feet thick occur at depths of 40 to 100 feet bgs. From a depth of 100 to 205 feet (total depth of the boreholes), the dominant soil type is silty sand with varying amounts of clay. In borehole 21MW2, a fairly thick sequence of clean sand (both poorly graded and well graded) was present from 113 feet to 144 feet bgs (31 feet thick). However, this thick sand unit was not seen or found in borehole 21MW3, indicating that these layers are laterally discontinuous. Bedrock (granitic rock) was not encountered in either of the continuously cored boreholes.

3.2.3.3 Groundwater.

Groundwater occurred beneath the site in 1993 at a depth of approximately 190 feet. Depth to water in 1997 was approximately 165 feet In 1998, depth to water in 21MW2 and 21MW 3 was identified at approximately 155 feet bgs. The thickness of the saturated alluvium and weathered bedrock is unknown. At varying depths, the thin, finer-grained strata may act as local confining beds within the alluvium, but typically these beds are not laterally continuous No additional monitoring wells were installed during the OU4 RI because depth-discrete groundwater samples collected during drilling did not indicate that groundwater contamination was an issue at the site

3.2.4 Nature and Extent of Contamination

Characterization at this site included depth-discrete groundwater sampling during drilling and shallow hand-auger soil borings to the depth of the former pond substratum. Analytical results indicated that no significant concentrations of contaminants were present that warranted further investigation or clean up actions. Complete analytical data are included in Appendix A.

3.2.4.1 Soil Contamination.

Surface soil samples collected at Site 21 indicate that several VOCs, SVOCs, pesticides, and metals were present at the site (Table 3-4) Organic compounds and pesticides were detected at low concentrations. Analytical results show that antimony was not detected above the reporting limits (RL) (10.1 to 11.4 mg/kg) or the method detection limit (MDL) (1.8 to 2.1 mg/kg) in any sample collected at Site 21. Arsenic was detected above the MDL (2.2 to 2.5 mg/kg) in 7 of 22 samples but was not detected above the RL of 40.2 to 45 6 mg/kg. Beryllium was detected in all samples above the MDL (0.080 to 0.091 mg/kg), but no samples had concentrations above the RL of 1.0 to 1.1 mg/kg. Comparing inorganic compounds with background samples collected during the OU2 investigation, it appears that aluminum, total chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, sodium, vanadium, and thallium are present at Site 21 above their respective background concentrations. Arsenic, molybdenum, and silver were also detected at Site 21 but at concentrations consistent with background levels established for OU2.

3.2.4.2 Groundwater Contamination.

Screening level groundwater samples collected during drilling had trace levels of methylene chloride and chloroform present in some samples at levels typically between the RL and the MDL. The detected concentrations of methylene chloride and chloroform are below both drinking water PRGs and established Federal MCLs. Neither methylene chloride nor chloroform was detected in subsurface soils suggesting other potential sources for their occurrence in groundwater. Methylene chloride is a common laboratory contaminant. In addition, various inorganics were detected at concentrations above the RL (Table 3-5). Alkalinity ranged from 142 to 230 mg/L in the six samples collected. Chloride was detected at concentrations ranging 146 to 227 mg/L and sulfate was present at concentrations ranging from 20 3 to 120 mg/L TDS ranged from 449 to 763 mg/L and hardness ranged from 232 to 616 mg/L.

Groundwater monitoring well 21 MW1 which was installed during the OU1 RI/FS was sampled by Tetra Tech for 9 quarters (Fall 1996 through Winter 1998-1999) for VOCs and 2 quarters of sampling for general minerals and metals (Fall 1996 through Winter 1996-1997). Based on analytical results for inorganics, the analysis of groundwater samples for metals was discontinued after two quarters of sampling because metals were not determined to be a contaminant of concern

Table 3-4. Site 21 Analytical Results for Soil

Chemical	Number of Detects	Sample Size[a]	Freq of Detects	Minimum (mg/kg)	Maximum (mg/kg)	Background UTL Conc. (mg/kg)	Carcinogenic PRG[b] (mg/kg)	Non-carcinogenic PRG[b] (mg/kg)
Volatile and Semi-volatile Organic Chemicals (Method 8260B and 8270C)								
1,2,3-Trichlorobenzene	9	22	41%	8.50E-04	1.90E-03	--	--	--
1,2,4-Trichlorobenzene	9	22	41%	8.20E-04	1.90E-03	--	--	6.46E+02
1,2,4-Trimethylbenzene	1	22	5%	9.50E-04	1.00E-03	--	--	5.70E+00
1,2-Dichlorobenzene	1	22	5%	1.00E-03	8.20E-03	--	--	3.70E+02
1,2-Dichloroethane	5	22	23%	6.90E-04	8.50E-03	--	3.46E-01	1.07E+01
1,3,5-Trimethylbenzene	1	22	5%	1.10E-03	1.65E-03	--	--	2.13E+01
Hexachlorobutadiene	5	22	23%	8.70E-04	2.50E-03	--	6.24E+00	1.22E+01
Naphthalene	14	22	64%	1.00E-03	3.20E-03	--	--	5.59E+01
n-Butylbenzene	1	22	5%	7.40E-04	2.50E-03	--	--	1.45E+02
Pesticides (Method 8081)								
4,4'-DDE	1	22	5%	1.25E-02	2.50E-02	--	1.72E+00	--
4,4'-DDT	2	22	9%	4.90E-04	1.80E-02	--	1.72E+00	3.61E+01
alpha-Chlordane	1	22	5%	6.20E-04	7.50E-03	--	1.62E+00	3.52E+01
gamma-Chlordane	2	22	9%	8.20E-04	7.50E-03	--	1.62E+00	3.52E+01
Metals (Methods 6010B)								
Aluminum	22	22	100%	1.23E+04	2.56E+04	1.3E+04	--	7.61E+04
Arsenic	7	22	32%	2.60E+00	3.00E+00	3.3E+00	3.90E-01	2.16E+01
Barium	22	22	100%	1.35E+02	1.09E+02	2.89E+02	--	5.37E+03
Beryllium	22	22	100%	4.20E-01	8.70E-01	2.56E+01	2.5E+02	1.54E+02
Cadmium	22	22	100%	3.50E-01	1.50E+00	7.20E-01	3.7E+02	9.00E+00
Calcium	22	22	100%	1.42E+03	6.20E+03	4.52E+03	--	--
Total Chromium	22	22	100%	1.44E+01	4.76E+01	1.95E+01	2.10E+02	2.35E+02
Cobalt	22	22	100%	8.30E+00	2.06E+01	1.28E+01	--	4.69E+03
Copper	22	22	100%	1.01E+01	6.48E+01	1.48E+01	--	2.91E+03
Iron	**22**	**22**	**100%**	**1.66E+04**	**3.49E+04**	**2.10E+04**	**--**	**2.30E+04**
Lead[1]	22	22	100%	2.30E+00	5.82E+01	4.07E+01	--	1.50E+02
Magnesium	22	22	100%	4.56E+03	1.11E+04	6.40E+03	--	--
Manganese	22	22	100%	1.82E+02	8.06E+02	4.02E+02	--	1.80E+03
Molybdenum	4	22	20%	8.80E-01	1.15E+01	2.61E+00	--	3.90E+02
Nickel	22	22	100%	6.80E+00	1.27E+01	8.51E+00	--	1.60E+03
Potassium	22	22	100%	4.94E+03	1.20E+04	6.31E+03	--	--
Selenium	22	22	100%	5.30E+00	6.00E+00	ND	--	3.90E+02
Silver	4	22	20%	4.90E-01	1.99E+01	ND	--	3.90E+02
Sodium	22	22	100%	9.26E+01	5.24E+02	2.67E+02	--	--
Thallium	**22**	**22**	**100%**	**2.01E+01**	**2.28E+01**	**ND**	**--**	**5.20E+00**
Vanadium	22	22	100%	3.12E+01	8.44E+01	4.81E+01	--	5.50E+02
Zinc	22	22	100%	3.51E+01	1.03E+02	8.10E+01	--	2.30E+04

Note: [a] Sample size does not include field or laboratory quality control samples
Residential Preliminary Remediation Goals are based on cancer risk or non-carcinogenic health effects
[b] U.S. EPA October 2002, List of Preliminary Remediation Goals.
-- = No data or not applicable
mg/kg = milligrams per kilogram
DDE = P,P-dichlorodiphenyl dichloroethylene
DDT = P,P-dichlorodiphenyl trichlorothylene
PRG = Preliminary Remediation Goal
UTL = Upper Tolerance Limit

discrete groundwater samples collected during drilling did not indicate that groundwater contamination was an issue at the site

3.2.4 Nature and Extent of Contamination

Characterization at this site included depth-discrete groundwater sampling during drilling and shallow hand-auger soil borings to the depth of the former pond substratum. Analytical results indicated that no significant concentrations of contaminants were present that warranted further investigation or clean up actions. Complete analytical data are included in Appendix A.

3.2.4.1 Soil Contamination.

Surface soil samples collected at Site 21 indicate that several VOCs, SVOCs, pesticides, and metals were present at the site (Table 3-4) Organic compounds and pesticides were detected at low concentrations Analytical results show that antimony was not detected above the reporting limits (RL) (10.1 to 11.4 mg/kg) or the method detection limit (MDL) (1.8 to 2.1 mg/kg) in any sample collected at Site 21. Arsenic was detected above the MDL (2.2 to 2.5 mg/kg) in 7 of 22 samples but was not detected above the RL of 40.2 to 45.6 mg/kg Beryllium was detected in all samples above the MDL (0.080 to 0.091 mg/kg), but no samples had concentrations above the RL of 1.0 to 1.1 mg/kg. Comparing inorganic compounds with background samples collected during the OU2 investigation, it appears that aluminum, total chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, sodium, vanadium, and thallium are present at Site 21 above their respective background concentrations. Arsenic, molybdenum, and silver were also detected at Site 21 but at concentrations consistent with background levels established for OU2.

3.2.4.2 Groundwater Contamination.

Screening level groundwater samples collected during drilling had trace levels of methylene chloride and chloroform present in some samples at levels typically between the RL and the MDL The detected concentrations of methylene chloride and chloroform are below both drinking water PRGs and established Federal MCLs. Neither methylene chloride nor chloroform was detected in subsurface soils suggesting other potential sources for their occurrence in groundwater. Methylene chloride is a common laboratory contaminant In addition, various inorganics were detected at concentrations above the RL (Table 3-5). Alkalinity ranged from 142 to 230 mg/L in the six samples collected. Chloride was detected at concentrations ranging 146 to 227 mg/L and sulfate was present at concentrations ranging from 20.3 to 120 mg/L. TDS ranged from 449 to 763 mg/L and hardness ranged from 232 to 616 mg/L.

Groundwater monitoring well 21 MW1 which was installed during the OU1 RI/FS was sampled by Tetra Tech for 9 quarters (Fall 1996 through Winter 1998-1999) for VOCs and 2 quarters of sampling for general minerals and metals (Fall 1996 through Winter 1996-1997) Based on analytical results for inorganics, the analysis of groundwater samples for metals was discontinued after two quarters of sampling because metals were not determined to be a contaminant of concern

Table 3-4. Site 21 Analytical Results for Soil

Chemical	Number of Detects	Sample Size[a]	Freq of Detects	Minimum (mg/kg)	Maximum (mg/kg)	Background UTL Conc (mg/kg)	Carcinogenic PRG[b] (mg/kg)	Non-carcinogenic PRG[b] (mg/kg)
Volatile and Semi-volatile Organic Chemicals (Method 8260B and 8270C)								
1,2,3-Trichlorobenzene	9	22	41%	8.50E-04	1.90E-03	--	--	--
1,2,4-Trichlorobenzene	9	22	41%	8.20E-04	1.90E-03	--	--	6.46E+02
1,2,4-Trimethylbenzene	1	22	5%	9.50E-04	1.00E-03	--	--	5.70E+00
1,2-Dichlorobenzene	1	22	5%	1.00E-03	8.20E-03	--	--	3.70E+02
1,2-Dichloroethane	5	22	23%	6.90E-04	8.50E-03	--	3.46E-01	1.07E+01
1,3,5-Trimethylbenzene	1	22	5%	1.10E-03	1.65E-03	--	--	2.13E+01
Hexachlorobutadiene	5	22	23%	8.70E-04	2.50E-03	--	6.24E+00	1.22E+01
Naphthalene	14	22	64%	1.00E-03	3.20E-03	--	--	5.59E+01
n-Butylbenzene	1	22	5%	7.40E-04	2.50E-03	--	--	1.45E+02
Pesticides (Method 8081)								
4,4'-DDE	1	22	5%	1.25E-02	2.50E-02	--	1.72E+00	--
4,4'-DDT	2	22	9%	4.90E-04	1.80E-02	--	1.72E+00	3.61E+01
alpha-Chlordane	1	22	5%	6.20E-04	7.50E-03	--	1.62E+00	3.52E+01
gamma-Chlordane	2	22	9%	8.20E-04	7.50E-03	--	1.62E+00	3.52E+01
Metals (Methods 6010B)								
Aluminum	22	22	100%	1.23E+04	2.56E+04	1.3E+04	--	7.61E+04
Arsenic	7	22	32%	2.60E+00	3.00E+00	3.3E+00	3.90E-01	2.16E+01
Barium	22	22	100%	1.35E+02	1.09E+02	2.89E+02	--	5.37E+03
Beryllium	22	22	100%	4.20E-01	8.70E-01	2.56E+01	2.5E+02	1.54E+02
Cadmium	22	22	100%	3.50E-01	1.50E+00	7.20E-01	3.7E+02	9.00E+00
Calcium	22	22	100%	1.42E+03	6.20E+03	4.52E+03	--	--
Total Chromium	22	22	100%	1.44E+01	4.76E+01	1.95E+01	2.10E+02	2.35E+02
Cobalt	22	22	100%	8.30E+00	2.06E+01	1.28E+01	--	4.69E+03
Copper	22	22	100%	1.01E+01	6.48E+01	1.48E+01	--	2.91E+03
Iron	**22**	**22**	**100%**	**1.66E+04**	**3.49E+04**	**2.10E+04**	**--**	**2.30E+04**
Lead[1]	22	22	100%	2.30E+00	5.82E+01	4.07E+01	--	1.50E+02
Magnesium	22	22	100%	4.56E+03	1.11E+04	6.40E+03	--	--
Manganese	22	22	100%	1.82E+02	8.06E+02	4.02E+02	--	1.80E+03
Molybdenum	4	22	20%	8.80E-01	1.15E+01	2.61E+00	--	3.90E+02
Nickel	22	22	100%	6.80E+00	1.27E+01	8.51E+00	--	1.60E+03
Potassium	22	22	100%	4.94E+03	1.20E+04	6.31E+03	--	--
Selenium	22	22	100%	5.30E+00	6.00E+00	ND	--	3.90E+02
Silver	4	22	20%	4.90E-01	1.99E+01	ND	--	3.90E+02
Sodium	22	22	100%	9.26E+01	5.24E+02	2.67E+02	--	--
Thallium	**22**	**22**	**100%**	**2.01E+01**	**2.28E+01**	**ND**	**--**	**5.20E+00**
Vanadium	22	22	100%	3.12E+01	8.44E+01	4.81E+01	--	5.50E+02
Zinc	22	22	100%	3.51E+01	1.03E+02	8.10E+01	--	2.30E+04

Note: [a] Sample size does not include field or laboratory quality control samples
Residential Preliminary Remediation Goals are based on cancer risk or non-carcinogenic health effects.
[b] U.S. EPA October 2002, List of Preliminary Remediation Goals
-- = No data or not applicable
mg/kg = milligrams per kilogram
DDE = P,P-dichlorodiphenyl dichloroethylene
DDT = P,P-dichlorodiphenyl trichlorothylene
PRG = Preliminary Remediation Goal
UTL = Upper Tolerance Limit

Table 3-5. Site 21 Analytical Results for Groundwater

Chemical	Number of Detects	Sample Size a	Freq. of Detects	Minimum	Maximum	Maximum Background	Maximum Contaminant Level (MCL)	Secondary MCL (EPA)	EPA Tap Water PRG
Volatile Organic Chemicals (Method 8260B) (µg/L)									
Methylene Chloride	2	6	33%%	0.24F	0.25F	--	5.0	--	4.3
Chloroform	3	6	50%	0.39F	0.68	--	100	--	6.2
General Chemistry (mg/L)									
Alkalinity	6	6	100%	142	230	360	--		--
Alkalinity Bicarbonate	6	6	100%	142	230	360	--		--
Chloride	6	6	100%	146	227	580	--	250	--
Sulfate	6	6	100%	20.3	120	797.5	500	500	--
Total Dissolved Solids	6	6	100%	466	763	2300	--		--
Hardness	6	6	100%	232	616	1330			--
In-Organics (Method 6010B) (mg/L)									
Aluminum	**6**	**6**	**100%**	**20.1**	**67.9**	**2.07**	**1.0**	**0.05-0.2**	**36**
Antimony	2	6	33%	0.0024F	0.0032F	0.142	0.006	0.006	0.015
Arsenic	4	6	66%	0.0077F	0.020F	--	0.05	--	0.000045
Barium	6	6	100%	0.51	0.87	0.516	1.0	--	2.6
Beryllium	4	6	66%	0.00077F	0.0028F	0.0314	0.004	--	0.073
Cadmium	5	6	83%	0.0014F	0.0063F	0.0289	0.005	--	0.018
Calcium	6	6	100%	54.0	111	328	--	--	--
Total Chromium	6	6	100%	0.028	0.13	0.0512	0.05	--	55 * 0.110 **
Cobalt	6	6	100%	0.0041F	0.081F	0.0278	--	--	0.730
Copper	6	6	100%	0.014	0.066	0.0299	1.3	1.0	1.5
Iron	**6**	**6**	**100%**	**54.7**	**268**	**3.7**	**--**	**0.3**	**11.0**
Lead	5	6	83%	0.0022F	0.025	--	0.015	--	3.6
Magnesium	6	6	100%	23.7	82.3	123	--	--	--
Manganese	**6**	**6**	**100%**	**0.91**	**2.4**	**0.111**	**--**	**0.05**	**0.880**
Molybdenum	6	6	100%	0.022	0.084	0.128	--	--	0.180
Nickel	6	6	100%	0.010F	0.049	0.644	0.1	--	0.730
Potassium	6	6	100%	6.5	49.7	14.4	--	--	--
Sodium	6	6	100%	75.1	96.4	264	--	--	--
Thallium	1	6	17%	0.0074F	0.0074F	0.197	0.002	--	0.0024
Vanadium	6	6	100%	0.053	**0.48**	**0.0684**	--	--	**0.260**
Zinc	6	6	100%	0.073	0.47	0.0588	--	5.0	11

Notes: * EPA tap water PRG for Chromium III
** EPA tap water PRG for Chromium VI
mg/kg = milligrams per kilogram
-- = No data or not applicable
µg/L = micrograms per liter
PRG = USEPA Region IX Preliminary Remediation Goal

at Site 21. VOC analysis was discontinued after 9 quarters of sampling because the level of contamination was minor and sporadic

3.2.4.3 Site Characterization Summary.

Based on soil samples collected at Site 21 during the OU1 and OU4 field investigations, contamination at Site 21 was limited to low concentrations of inorganic constituents in shallow subsurface soils During a preliminary site walk completed in October 1997, the site had been graded and the bermed areas that were present during the OU1 investigation had been removed. Approximately 2 to 3 feet of fill (possibly from the berm) was deposited on top of the original ground surface. A site visit in June 2003 showed that the site has been completely redeveloped into a Ross Department Store Warehouse Distribution Facility, and no evidence of the effluent pond could be identified in the field

3.2.5 Potential Migration Pathways

Transport mechanisms of concern at Site 21 are those that act upon subsurface soils Contaminant transport via air pathways is not a major concern, as the soils in question were buried beneath 2 to 3 feet of fill In addition, as a result of recent development, impacted soils have been graded and mixed, and currently lie below the landscaped berm at 5 to 6 feet below grade or are covered with asphalt beneath a parking apron. Potential migration pathways may include direct contact with soil as a result of trenching or other excavation activities, but exposure levels associated with current workers are nonexistent since overlying fill material and asphalt paving preclude direct contact. With the recent redevelopment, it is highly unlikely that the site would be used for residential development.

Site 21 has a limited capacity to transport site contaminants from the subsurface to the groundwater. This transport method is limited to leaching of inorganic constituents from soils and transport into groundwater beneath the site via infiltration of precipitation. Groundwater is encountered at depths over 150 feet bgs. The degree of infiltration is severely limited in areas of asphalt paving With much of the area paved in asphalt and future residential development unlikely to cause significant disturbance of ground surface, transport mechanisms are limited at the site

3.2.6 Risk Assessment

Several VOCs and SVOCs were detected in surface soil at Site 21 in addition to pesticides. As shown in Table 3-4, all detected VOCs, SVOCs, and pesticides were below residential PRGs as defined by U.S. EPA Region IX (October 2002). Of the 23 inorganic compounds analyzed, 22 were routinely detected. Of the 22 detected inorganic compounds, only iron and thallium were at levels above both the March AFB background levels and residential PRGs (unrestricted reuse levels).

Subsurface Soils. Carcinogenic risk and hazard evaluations of subsurface soils for Site 21 were estimated for both the residential and industrial worker receptors

(Table 3-6). Although future residents are highly unlikely to reside on-site, estimation of their risk allows for the assessment of future land-use restrictions. Risk from each chemical of potential concern (COPC) was assessed by taking the ratio of the exposure point concentration (EPC) to the respective PRG (with an additional factor of 10^{-6} for carcinogens). For subsurface soils, EPCs were the lower value between the maximum detection and the calculated 95% upper confidence limit (UCL) of the mean (Table 3-6). The potential risk from exposure to all COPCs is presented by summing the risks of each chemical The risk attributable to background levels of inorganic constituents is also presented

Carcinogenic risk to the theoretical resident from subsurface soils is 8 x 10^{-6} While exceeding 10^{-6}, this risk estimate is within EPA's acceptable risk range of 10^{-6} to 10^{-4} (Table 3-6). The potential risk to the future industrial worker is reduced to slightly above 10^{-6}. Most (i.e., 75%) of this risk is due to background levels of arsenic For exposure to non-carcinogens, iron and thallium pose a slight non-carcinogenic hazard based on levels of these analytes in subsurface soils. The residential reasonable maximum exposure (RME) hazard index (HI) is 6, which slightly exceeds the target HI of 1. However, the industrial HI index at Site 21 due to iron and thallium is below 1.0.

Arsenic was detected at levels above the residential PRG, but was determined to be within the range of background concentrations observed at March AFB. Iron and thallium were also detected at levels above the residential PRGs However, because iron was only slightly higher than background levels for March, it may be interpreted to be within background levels.

In a detailed study of inorganics at McClellan AFB near Sacramento, California, arsenic, lead, thallium, antimony, and cadmium concentrations analyzed by EPA Method SW6010 were recognized as potentially problematic. In detailed studies on thallium, false-positive thallium data were determined to be caused by aluminum interference. As reported at McClellan, thallium concentrations using SW6010 analytical techniques were artificially increased because of the interference from high aluminum concentrations in soil (Jacobs Engineering Group, Inc., 1998). Jacobs Engineering Group demonstrated that as aluminum concentrations in soil samples analyzed by Method SW6010 increased, there was a corresponding increase in thallium concentrations reported. However, when comparing the thallium concentrations reported from the SW6010 analysis with thallium concentrations obtained from the same samples using method SW7841 (specific for thallium), the thallium concentrations were considerably different. In samples containing aluminum concentrations of 2,200 mg/kg to 4,870 mg/kg, thallium was reported at 16.1 mg/kg to 28.2 mg/kg using Method SW6010, whereas thallium concentrations ranged from 0.141 mg/kg to 0.467 mg/kg using Method SW7841. In soil samples containing aluminum at a concentration of 29,100 mg/kg, thallium was reported at 202 mg/kg using Method SW6010 and was reported at 0.687 mg/kg using Method SW7841. For March Site 21, aluminum concentrations range from 12,500 mg/kg to 25,600 mg/kg. Therefore, high concentrations of aluminum in March Site 21 soil are likely causing anomalously high thallium concentrations due to aluminum interferences in the SW6010 analytical method To further support the questionable thallium results, there has been no known source for thallium on March AFB If the

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Table 3-6: Comparison of Constituent Concentrations in Soil to Residential and Industrial PRGs and Associated Risk, March AFB/ARB, Site 21

								Residential		Industrial			Residential Comparisons							Industrial Comparisons						Background Evaluation			
														Carcinogenic			Noncarcinogenic			Carcinogenic			Noncarcinogenic						
Chemical	Number of Detects	Sample Size [a]	Frequency of Detection	Maximum Conc. (mg/kg) [b]	95% UCL of Arithmetic Mean (mg/kg)	EPC (mg/kg) [c]	Background EPC[d] (mg/kg)	Carcinogenic PRG [e] (mg/kg)	Non-carcinogenic PRG [e] (mg/kg)	Carcinogenic PRG [e] (mg/kg)	Non-carcinogenic PRG [e] (mg/kg)	SSL DAF 1 (mg/kg)[f]	>SSL	>PRG (ca)	Excess Cancer Risk [g]	% Contribution to Risk	>PRG (nc)	HQ [h]	% Contribution to HI	>PRG (ca)	Excess Cancer Risk [i]	% Contribution to Risk	>PRG (nc)	HQ [j]	% Contribution to HI	EPC > Background?	Excess Risk due to Background[j]	Hazard due to Background[j]	Notes
Volatile and Semi-volatile Organic Chemicals (Method 8260B and 8270C)																													
1,2,3-Trichlorobenzene	9	20	45%	1.9E-03	1.2E-03	1.2E-03	--					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
1,2,4-Trichlorobenzene	9	20	45%	1.9E-03	1.2E-03	1.2E-03	--		6.5E+02		5.6E+03	3.0E-01	No	--	--	--	No	2.9E-06	0%	--	--	--	No	2.2E-07	0%	--	--	--	
1,2,4-Trimethylbenzene	1	20	5%	9.5E-04	--	9.5E-04	--		5.2E+01		1.7E+02	--	--	--	--	--	No	1.8E-05	--	--	--	--	No	--[d]	--	--	--	--	
1,2-Dichlorobenzene	1	20	5%	8.2E-03	--	8.2E-03	--		3.7E+02		4.1E+03	9.0E-01	No	--	--	--	No	2.2E-05	--	--	--	--	No	--[d]	--	--	--	--	sat [e]
1,2-Dichloroethane	5	20	25%	8.5E-03	2.2E-03	2.2E-03	--	2.8E-01	8.5E+00	6.0E-01	2.8E+01	1.0E-03	Yes	No	7.7E-09	0%	No	1.0E-03	0%	No	3.6E-09	0%	No	7.7E-05	0%				
1,3,5-Trimethylbenzene	1	20	5%	1.1E-03	--	1.1E-03	--		2.1E+01		7.0E+01	--	--	--	--	--	No	5.2E-05	0%	--	--	--	No	1.6E-05	0%	--	--	--	
Hexachlorobutadiene	5	20	25%	1.3E-03	2.6E-03	1.3E-03	--	6.2E+00	1.8E+01	2.2E+01	1.8E+02	1.0E-01	No	No	2.1E-10	0%	No	7.1E-05	0%	No	5.9E-11	0%	No	7.0E-06	0%				
Naphthalene	14	20	70%	3.2E-03	2.3E-03	2.3E-03	--		5.6E+01		1.9E+02	4.0E+00	No	--	--	--	No	5.7E-05	0%	--	--	--	No	1.2E-05	0%	--	--	--	
n-Butylbenzene	1	20	5%	7.4E-04	--	7.4E-04	--		5.8E+02		2.2E+03	--	--	--	--	--	No	1.3E-06	0%	--	--	--	No	3.4E-07	0%	--	--	--	
Polychlorinated Biphenyls (Method 8082A)																													
None detected																													
Pesticides (Method 8081)																													
4,4'-DDE	1	20	5%	2.5E-02	--	2.5E-02	--	1.72E+00		7.0E+00		3.0E+00	No	No	1.5E-08	0%	--	--	--	No	3.6E-09	0%	--	--	--	--	--	--	
4,4'-DDT	2	20	10%	1.8E-02	--	1.8E-02	--	1.72E+00		7.0E+00		2.0E+00	No	No	1.0E-08	0%	--	--	--	No	2.6E-09	0%	--	--	--	--	--	--	
alpha-Chlordane	1	20	5%	6.2E-04	--	6.2E-04	--	1.62E+00	3.52E+01	6.5E+00	4.0E+02	5.0E-01	No	No	3.8E-10	0%	No	1.8E-05	0%	No	9.6E-11	0%	No	1.5E-06	0%	--	--	--	
gamma-Chlordane	2	20	10%	4.3E-03	--	4.3E-03	--	1.62E+00	3.52E+01	6.5E+00	4.0E+02	5.0E-01	No	No	2.6E-09	0%	No	1.2E-04	0%	No	6.6E-10	0%	No	1.1E-05	0%	--	--	--	
Metals (Methods 6010B)																													
Aluminum	20	20	100%	2.6E+04	2.0E+04	2.0E+04	2.13E+04	--	1E+5 max	--	7.6E+04	--	--	--	--	--	No	No	--[k]	--	--	--	No	2.7E-01	36%	No	--	--	
Arsenic	5	20	25%	3.0E+00	3.3E+01	3.0E+00	6.50E+00	3.9E-01	2.2E+01	1.6E+00	2.6E+02	1.0E+00	Yes	Yes	7.7E-06	98%	No	1.4E-01	2%	Yes	1.9E-06	96%	No	1.2E-02	2%	No	1.7E-05	3.0E-01	
Barium	20	20	100%	2.9E+02	2.1E+02	2.1E+02	9.16E+02		5.4E+03		6.7E+04	8.2E+01	Yes	--	--	--	No	5.4E-02	1%	--	--	--	No	3.1E-03	0%	No	--	1.7E-01	
Beryllium	19	20	95%	8.1E-01	6.6E-01	6.6E-01	1.285E-00	1.1E+03	1.5E+02	2.2E+03	1.9E+03	3.0E+00	No	No	6.3E-10	0%	No	5.2E-03	0%	No	2.9E-10	0%	No	3.4E-04	0%	No	1.2E-09	8.3E-03	
Cadmium	20	20	100%	1.5E+00	4.7E-01	4.7E-01	1.285E-00	1.4E+03	3.7E+01	3.0E+03	4.5E+02	4.0E-01	Yes	No	3.3E-10	0%	No	4.1E-02	1%	No	1.6E-10	0%	No	1.0E-03	0%	No	9.1E-10	3.5E-02	
Calcium	20	20	100%	6.2E+03	2.9E+03	2.9E+03	1.65E+04					--	--	--	--	--	--	--	--	--	--	--	--	--	--	No	--	--	
Chromium	20	20	100%	4.8E+01	2.5E+01	2.5E+01	2.10E+01	2.1E+02		4.5E+02		2.0E+00	Yes	No	1.2E-07	2%	--	--	--	No	5.6E-08	3%	--	--	--	Yes	1.0E-07	--	
Cobalt	20	20	100%	2.1E+01	1.5E+01	1.5E+01	1.60E+01	9.0E+02	1.4E+03	1.9E+03	1.3E+04	--	--	No	1.6E-08	0%	No	1.5E-02	0%	No	7.6E-09	0%	No	1.1E-03	0%	No	1.8E-08	1.2E-02	
Copper	20	20	100%	6.5E+01	2.0E+01	2.0E+01	1.61E+01		3.1E+03		4.1E+04	--	--	--	--	--	No	2.1E-02	0%	--	--	--	No	4.9E-04	0%	Yes	--	5.1E-03	
Iron	20	20	100%	3.5E+04	2.7E+04	2.7E+04	3.17E+04		2.3E+04		3.1E+05	--	--	--	--	--	Yes	1.5E+00	21%	--	--	--	No	8.7E-02	12%	No	--	1.4E+00	
Lead[k]	20	20	100%	5.8E+01	1.0E+01	1.0E+01	4.07E+01		1.5E+02		7.5E+02	--	--	--	--	--	No	--[k]	--	--	--	--	No	--[k]	--	No	--	2.7E-01	
Magnesium	20	20	100%	1.1E+04	7.9E+03	7.9E+03	7.66E+03					--	--	--	--	--	--	--	--	--	--	--	--	--	--	Yes	--	--	
Manganese	20	20	100%	8.1E+02	4.7E+02	4.7E+02	7.36E+02		1.8E+03		1.9E+04	--	--	--	--	--	No	4.6E-01	7%	--	--	--	No	2.4E-02	3%	No	--	4.2E-01	
Molybdenum	4	20	20%	1.2E+01	2.5E+00	2.5E+00	3.125E+00		3.9E+02		5.1E+03	--	--	--	--	--	No	2.9E-02	0%	--	--	--	No	4.9E-04	0%	No	--	--	
Nickel[l]	20	20	100%	1.4E+01	1.0E+01	1.0E+01	1.025E+01		1.6E+03		2.0E+04	7.0E+00	Yes	--	--	--	No	8.7E-03	0%	--	--	--	No	5.0E-04	0%	No	--	6.6E-03	
Potassium	20	20	100%	1.2E+04	8.2E+03	8.2E+03	8.75E+03					--	--	--	--	--	--	--	--	--	--	--	--	--	--	No	--	--	
Selenium	20	20	100%	6.0E+00	5.7E+00	5.7E+00	1.25E+01		3.9E+02		5.1E+03	3.0E-01	Yes	--	--	--	No	1.5E-02	0%	--	--	--	No	1.1E-03	0%	No	--	--	
Silver	4	20	20%	2.0E+01	1.9E+00	1.9E+00	ND		3.9E+02		5.1E+03	2.0E+00	Yes	--	--	--	No	5.1E-02	1%	--	--	--	No	3.8E-04	0%	No	--	--	
Sodium	20	20	100%	5.2E+02	3.4E+02	3.4E+02	5.71E+02					--	--	--	--	--	--	--	--	--	--	--	--	--	--	No	--	--	
Thallium	20	20	100%	2.3E+01	2.2E+01	2.2E+01	ND		5.2E+00		6.7E+01	--	--	--	--	--	Yes	4.4E+00	64%	--	--	--	No	3.2E-01	44%	--	--	--	
Vanadium	20	20	100%	8.4E+01	6.3E+01	6.3E+01	6.28E+01		5.5E+02		7.2E+03	3.0E+02	No	--	--	--	No	1.5E-01	2%	--	--	--	No	8.8E-03	1%	No	--	1.1E-01	
Zinc	20	20	100%	1.0E+02	6.9E+01	6.9E+01	5.12E+02		3.1E+03		3.1E+05	6.2E+02	No	--	--	--	No	3.4E-02	0%	--	--	--	No	2.2E-04	0%	No	--	2.3E-02	
										Cumulative Excess Cancer Risk/Hazard Index:					**7.9E-06**			**6.9E+00**			**2.0E-06**			**7.3E-01**			**1.7E-05**	**2.7E+00**	

Notes:

--	= no data or not applicable	EPC	= Exposure point concentration	DDE	= p,p'-Dichlorodiphenyldichloroethylene	PRG	= Preliminary Remediation Goal
ca	= carcinogenic	%	= percent	DDT	= p,p'-Dichlorodiphenyltrichloroethane	HQ	= Hazard Quotient
nc	= noncarcinogenic	DAF	= Dilution attenuation factor	>	= greater than	SSL	= Soil Screening Level
mg/kg	= milligrams per kilogram	UTL	= Upper tolerance limit	RME	= Reasonable maximum exposure	sat	= soil saturation concentration
HI	= hazard index	ND	= Not detected	UCL	= Upper confidence limit	max	= ceiling limit concentration

[a] Sample size does not include field or laboratory quality control samples; field duplicate result is averaged with original sample result

[b] Maximum EPC is the maximum detected concentration of an analyte

[c] RME EPC is the minimum of either the 95% UCL of the arithmetic mean or the maximum EPC.
The 95% UCL is calculated as $e^{(mean + 0.5s^2 + sH/(n-1)^{0.5})}$, where mean = mean of the natural log transformed data; s = standard deviation of the natural log transformed data; H = H-statistic from EPA 1992; and n = number of samples

[d] Background value is the maximum of reported values from OU2 main base OU2 west base

[e] PRGs are based on cancer risk or noncarcinogenic health effects unless qualified with a "sat" or "max" (ceiling limit concentration). Excess cancer risks
or HQs are not calculated for chemicals of potential concern with non-risk-based PRGs (sat or max) which are discussed qualitatively in the Uncertainty Section of the text.

[f] SSLs for the protection of groundwater from EPA Region IX PRG table

[g] Excess cancer risk = 1E-06 x (EPC / Residential Carcinogenic PRG)

[h] HQ = EPC / Residential Noncarcinogenic PRG

[i] Excess cancer risk = 1E-06 x (EPC / Industrial Carcinogenic PRG)

[j] Hazard quotient = EPC / Industrial Noncarcinogic PRG

[k] Value for lead is a non-risk-based residential screening level

treated wastewater were contributing to increased thallium concentrations at Site 21, investigations at other similar sites (Site 23, Site 16, the current wastewater treatment plant) would have identified thallium as a chemical of concern Therefore, the thallium concentrations identified in Site 21 soil samples are interpreted to be anomalously high resulting from interference of aluminum in the SW6010 analytical method. Therefore thallium should not be considered a chemical of concern at Site 21

Other compounds in the soil samples were either not detected or detected at levels well below their respective residential PRGs. PCBs (analyzed by EPA Method 8082A) were not detected in any soil sample.

Uncertainty Analysis

Uncertainties and limitations are inherent in the risk assessment process. The level of certainty in the risk estimate depends upon the quality of data and models used to identify COPCs, calculate representative concentrations in soils, accurately estimate contaminant doses, and develop toxicity values. Contaminant doses and toxicity information are combined in generating residential and industrial PRGs. Discussion of some of the uncertainties inherent in the risk assessment focus on key factors believed to influence the risk assessment process and application to risk management activities. Uncertainties involved in each major step of the risk assessment process (i.e., exposure assessment, toxicity assessment, and risk characterization) are discussed separately below.

Uncertainties in Exposure Assessment. Uncertainty in the exposure assessment is a function of several factors, including but not limited to, the completeness/representativeness of the site data, identification of COPCs, assumptions regarding actual current and/or future site land use, and the identification of relevant receptors and the levels of exposure as a result of their activities.

Risk estimates require knowledge of how, and to what degree, persons are or become exposed to site contaminants. Current and potential future uses of the site determine the manner and degree of exposure. Land use assumptions are selected to realistically characterize current and future site use and evaluate the need for possible land use restrictions by comparing concentrations against the most stringent use (i.e., residential use). While the most realistic scenario for Site 21 is its ongoing use for industrial/commercial purposes, the assumption of residential use certainly overestimates risk but provides useful information in identifying the need for a potential deed or land use restriction.

For each selected land use, various exposure factors or parameters are included in algorithms that calculate the receptor-specific PRGs. The exposure assessment involves numerous assumptions and assigned values for these factors For many of these factors, an assigned value represents the best estimate for the variability seen in a range of possible values In protective PRGs, EPA Region IX has used standard conservative values for many of the exposure parameters to provide the necessary protectiveness of the resulting screening values. Conservative assumptions for many of the exposure parameters lead to a multiple level of protection in producing a highly protective screening value.

In summary, based on the assessment of sampling, land use, receptor selection, and associated activities and exposure factors, the exposure assessment is believed to overestimate risk.

Uncertainties in Toxicity Assessment. EPA's methodology for toxicity assessment was specifically designed to ensure that estimates of toxicity are protective of human health. Because uncertainties exist in the toxicity assessment process, numerous conservative (health-protective) approaches are used, so as not to underestimate dose-response or hazard potential. These health protective measures include:

- Uncertainty factors are 10 to 10,000 for non-carcinogenic reference doses (RfDs)
- Animal carcinogens are assumed to also cause cancer in humans.
- Humans are assumed to be more sensitive than the most sensitive laboratory species.
- Carcinogens are assumed to not have a threshold

For non-carcinogens, RfDs are developed using animal data that must be applied to human receptors for the risk assessment. The process typically involves application of several uncertainty factors (UFs) and modifying factors to animal test data that lower the RfD given extrapolation from animal tests to human health risk assessment. For instance, UFs of 10 are often applied to animal data to reduce a threshold dose ten-fold to arrive at the RfD. Overall, it is common to utilize toxicity factors that mathematically reduce toxicity data by factors of 1,000 or more in order to ensure protectiveness. For example, the UF for thallium is 3,000. This application of the UFs is likely to overestimate non-carcinogenic toxicity

For carcinogens, EPA uses a conservative mathematical model, the linearized multistage model, for low-dose extrapolation. Because it conservatively predicts a higher cancer risk for a given dose than other models, the linearized multistage model establishes a higher toxicity value for carcinogens than other models. Additionally, EPA identifies the cancer toxicity value or slope factor as the 95% UCL on the slope of the resulting dose-response curve. By using the 95% UCL of the slope, a 95 percent chance exists that the true slope of the dose-response curve (i.e., toxicity value) is lower. Therefore, this model provides a conservative (protective) estimate of cancer risk at low doses and is likely to overestimate the actual cancer risk.

Uncertainties in Risk Characterization. EPA guidance indicates that HQs resulting from various multiple chemicals should be considered additive (EPA 1989). In the absence of supporting data for synergy or antagonism, the assumption of additivity, most often exhibited when toxic chemicals affect the same target organs or biochemical pathways, could overestimate or underestimate potential cancer risk or HQs for receptors.

3.2.7 Conclusions

The primary contaminants of concern at Site 21 included metals, VOCs, and pesticides Held in the effluent pond as treated wastewater from the base, the effluent was used for irrigation of the surrounding agricultural land The boundaries of the effluent pond were physically well defined by a berm during the 1993 OU1 RI/FS, and the site covered an area of approximately 2 acres. During the OU1 RI, the site was used by private parties for illegal dumping The site was cleaned up prior to the becoming part of the sod farm in 1998 and it was reported that the County of Riverside oversaw the cleanup Following the filed investigation for OU4 RI, the property was sold and the site is currently part of a Ross Department Stores warehouse distribution facility.

Recent site visits and background investigations at Site 21 reveal that the former effluent pond has undergone redevelopment at least twice since the original OU1 investigation was performed. Between the OU1 investigation (1993) and the OU4 investigation (1998), the berms that were present to hold the treated effluent had been removed and the area was leveled and became part of the adjoining sod farm Between 1998 (when the OU4 samples were collected) and currently, the property was sold and redeveloped into a large warehouse distribution facility. According to grading plans for the construction of the warehousing facility, the area of the former pond has been extensively graded and resulted in a landscaped berm approximately 6 feet above grade on the west side of the former pond. A truck parking area approximately 8 feet below grade is situated on the east side of the former pond. With the extensive grading that has occurred at the site, no evidence of the former pond can be observed. In addition, a Phase I Site Assessment conducted by URS Corporation in 2001 did not identify any potential environmental conditions within the former effluent pond area.

Additional characterization of surface and shallow subsurface soils was evaluated as part of the OU4 investigation to confirm the presence or absence of contaminants and to define the lateral and vertical extent of contamination. Soil samples were analyzed for metals, pesticides, PCBs, and VOCs Results indicated that all VOCs, pesticides, PCBs, and most detected metals were at concentrations well below the residential PRGs. Arsenic concentrations exceeded EPA residential PRGs but were considered within the range of background concentrations for this metal at March AFB. It was concluded that arsenic was not the result of anthropogenic sources Iron and thallium were the only metals detected at levels above the residential PRGs and above background levels.

Assuming the concentrations for thallium using EPA Methods 6010 are correct, thallium exceeds the residential hazard level but is well below the industrial level. These risk values were calculated using conservative methods and assume exposure to subsurface soils during or subsequent to excavation activities. The likelihood of extended exposure to these excavated soils is low. The hazard estimate for thallium under either the residential or industrial exposure scenario is well below typical action levels for remediation. Due to the uncertainty surrounding the PRG for thallium (especially its toxicity), true hazard from thallium is almost assuredly lower. If one were to assume the high thallium values are the result of interference with high aluminum values as suggested above, the risk from thallium would likely be non-existent. In addition, because the site has undergone considerable redevelopment, the levels of iron and thallium currently present at the site are not anticipated to pose much risk. Based on these conclusions, the recommended remedial action alternative for soil at Site 21 is No Further Action (NFA).

3.2.8 Recommendations

Based on the levels of contamination detected and the fact that the site has been completely redeveloped into a warehouse distribution facility, Site 21 is recommended for NFA.

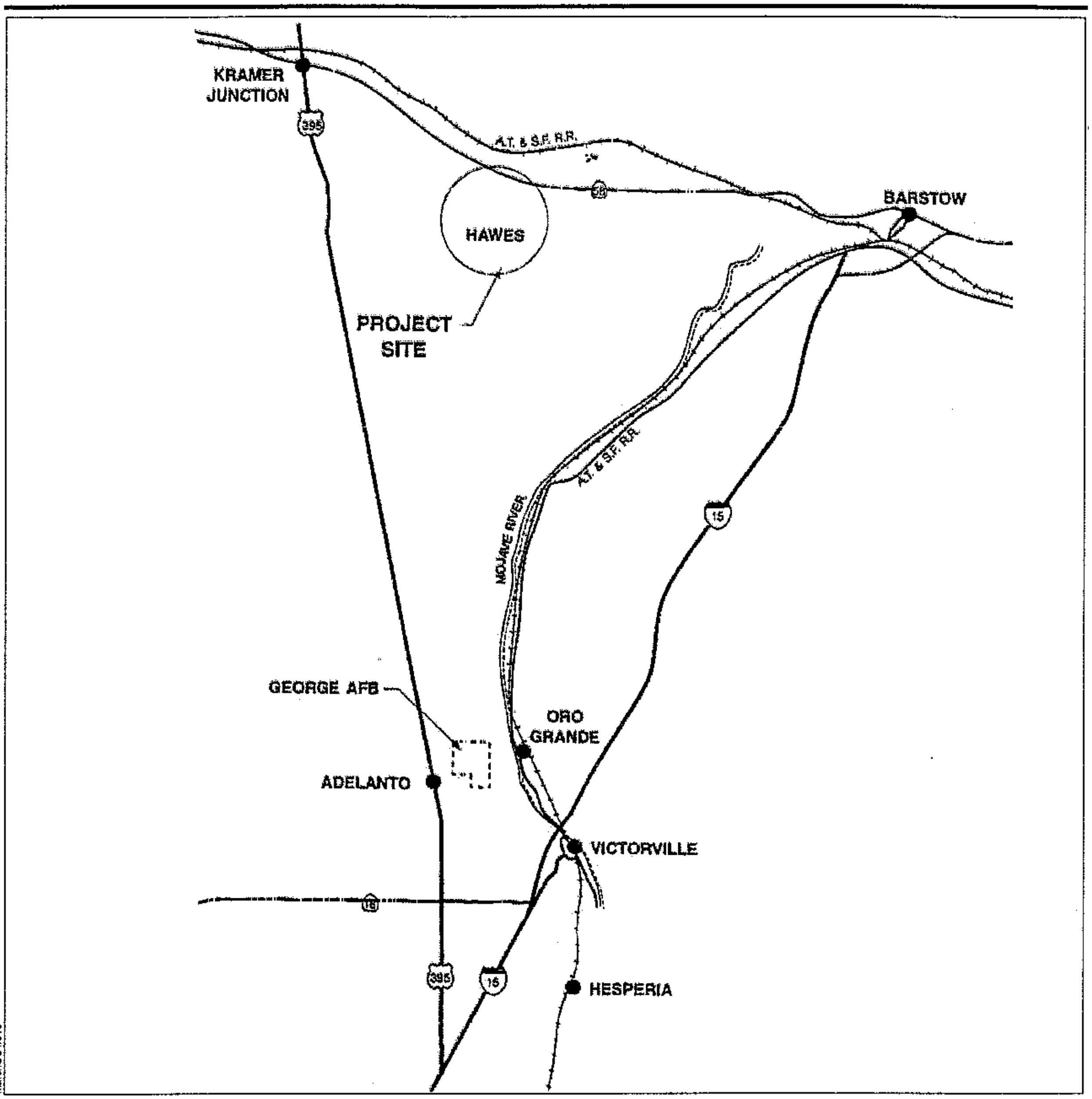
3.3 SITE 41

3.3.1 Site Background

Site 41, the former Hawes Radio Relay Station, is located approximately 1 mile south of State Highway 58 and 11 miles east of Kramer Junction (the intersection of State Highway 395 and State Route 58) in San Bernardino County, California (Figure 3-3). The Air Force leased an approximate 315-acre parcel from the Bureau of Land Management (BLM) in 1966 for construction and operation of a radio relay station (Figure 3-4). The station facilities included a septic system, storage tanks for water and petroleum products, four miles of runway, a radio tower, a water well, an aboveground bunker, and several support buildings (Figure 3-5). The Air Force closed the station in the mid-1980s, and most of the equipment and structures were subsequently vandalized or stolen. Destruction of the water supply well, and removal of underground storage tanks (oil, water, and septic) were performed by Tetra Tech (1998b). The two underground diesel tanks were removed by CKY (1996). Structures currently remaining at the site include the concrete bunker and the former airfield (Tetra Tech, 1998b)

3.3.1.1 Previous Investigations.

Investigations and removal actions were conducted intermittently between February 1995 and April 1996 and included a survey of asbestos-containing material (ACM) and lead-based paint; removal of identified ACM; destruction of the on-site water supply well; removal of underground structures such as oil, diesel, water, and septic tanks; confirmation soil sampling; and removal of contaminated soil. The ultimate goal was to achieve site closure for the property transfer from the Department of Defense back to Bureau of Land Management (BLM).

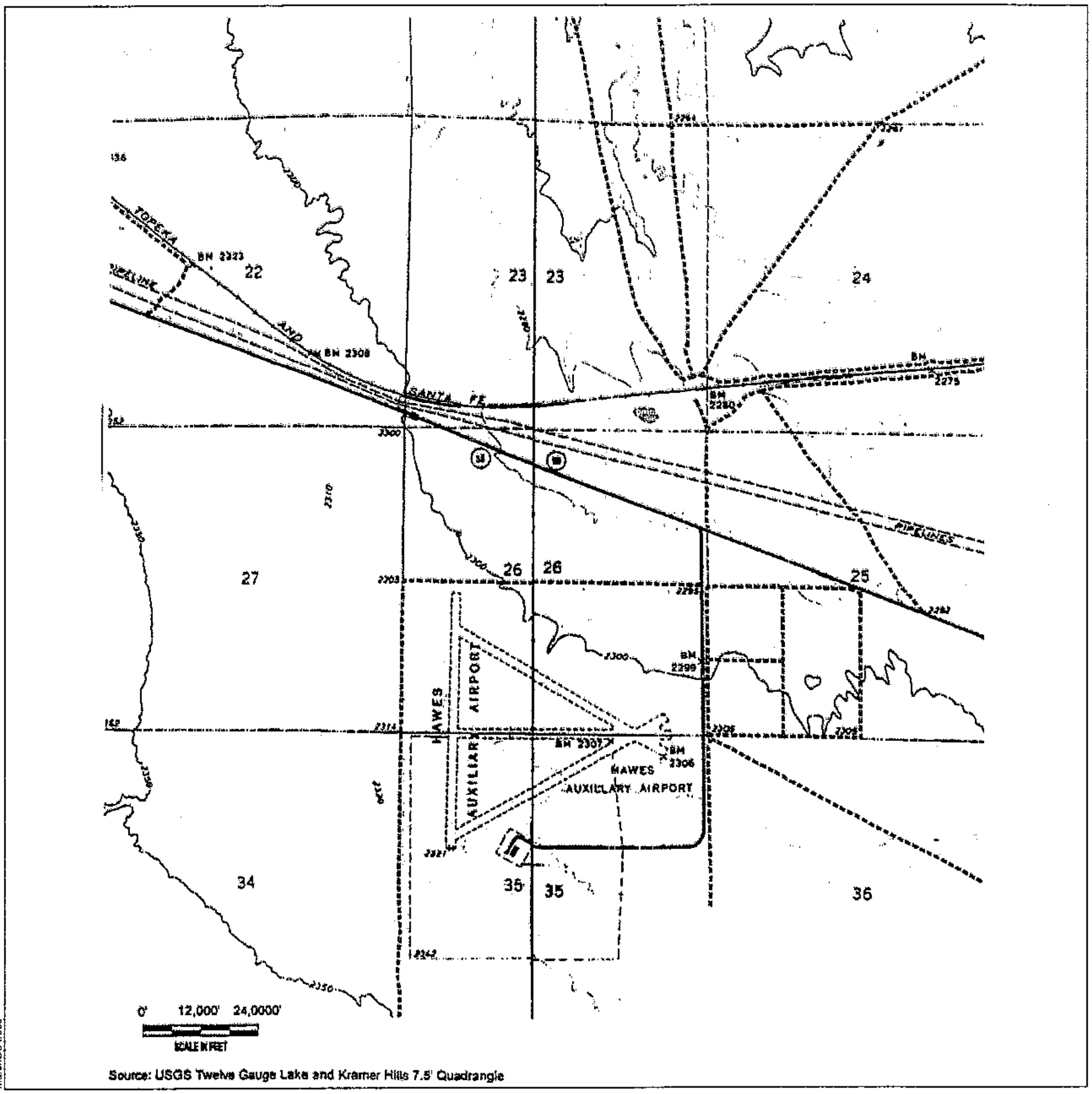


EXPLANATION

Site 41 Location Map

0 1.75 3.5 7 Miles

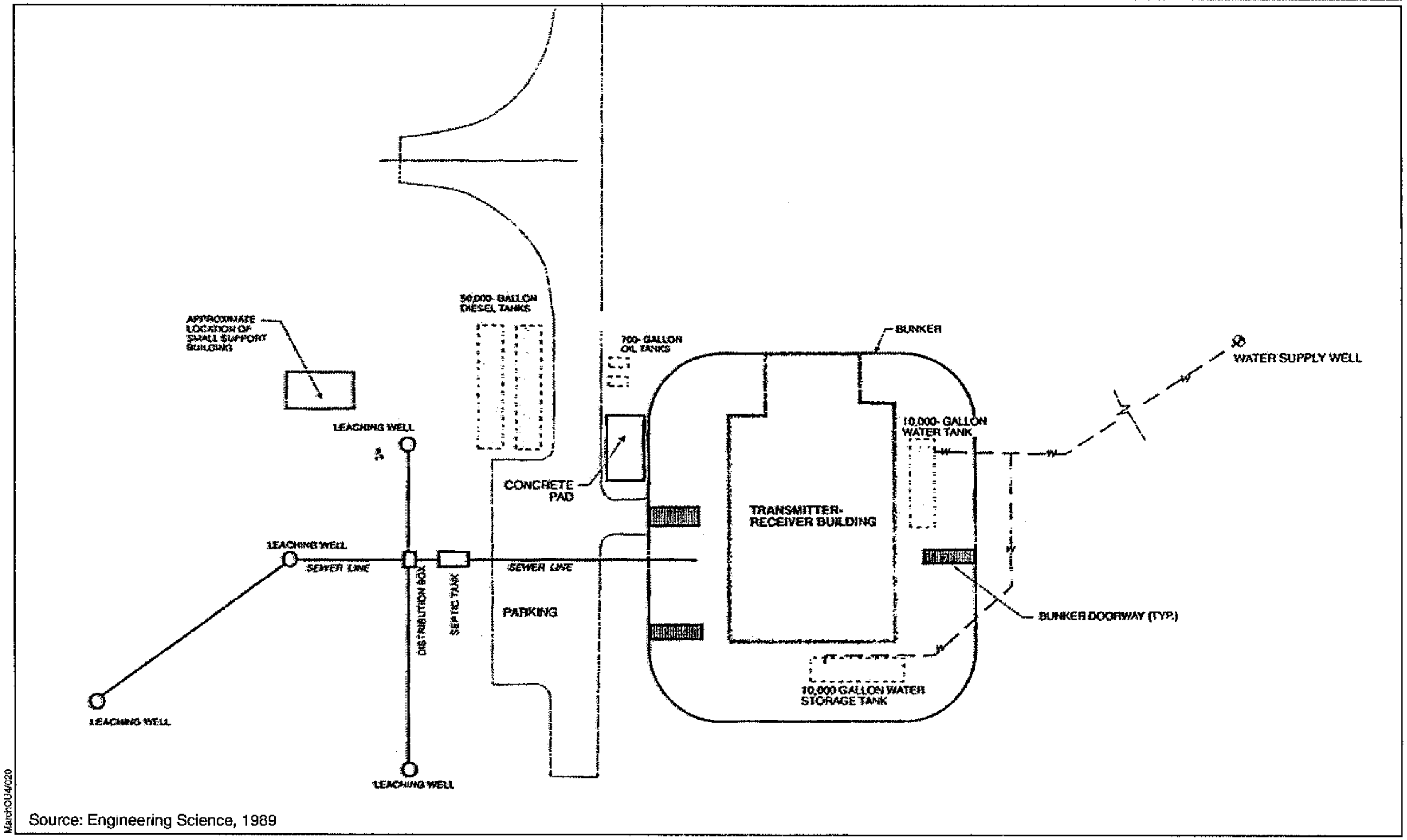
Figure 3-3



EXPLANATION

Site 41
Topographic Map

Figure 3-4



Source: Engineering Science, 1989

EXPLANATION

— — W — — Water Line

0 27.5 55 Feet

Site 41 Facilities

Figure 3-5

Specific investigations and activities included the following:

Geophysical Survey. A magnetometer survey of the site was conducted in February and March 1995 to locate possible disposal sites where metallic debris may have been buried An area approximately 3,500 feet by 4,000 feet (321 acres) centered on the bunker was included in the survey This area was divided into 500- by 500-foot square blocks and individually surveyed Major sources of anomalies were anchor blocks, antenna guy cables, outlying building foundations, utility vaults, and utility corridors leading from the bunker. Several small anomalies were mapped, which had no obvious surface or known underground source, but because they were located within the area of the antenna ground plane were not likely to have been disposal areas. An area in the northeast portion of the site had high amplitude magnetic anomalies and associated electromagnetic anomalies, but no visible sources. The area had been extensively graded due to its location beneath the former runway. The area is suspected to contain buried metallic objects. No other unidentified anomalies were identified within the site boundaries. The Base Closure Team (BCT) approved the site closure report in 1998 (Scandura, 1998, and Broderick, 1998).

Asbestos and Lead-Based Paint Sampling. An asbestos survey of the bunker (interior and exterior) was performed in August 1995 per USEPA Interim Method 600/M4-82-020, December 1982 (polarized light microscopy) Materials identified as ACM included floor tile, mastic, thermal system insulation, roofing material, exterior taring/felt, taping material, gaskets; and several areas of debris (Tetra Tech, 1998b).

The lead-based paint survey was performed in August 1995. Paint chips were collected, sealed in Ziploc™ bags, labeled, and analyzed for total lead by EPA Method 6010. Removal of lead-based paint was not performed, but debris containing lead-based paint was removed from the site (Tetra Tech, 1998b).

Asbestos Abatement and Debris Removal. Abatement of identified ACM was performed during October 1995 according to Occupational Safety and Health Administration and EPA regulations. Friable materials were double-bagged, placed in a plastic-lined roll-off bin, and transported to a Class III landfill (Azusa Land Reclamation in Azusa, California). A total of 96.6 tons of ACM were removed and properly disposed. Removal activities were performed in Level C personal protective equipment (PPE). Air samples were collected prior to, during, and following abatement activities (Tetra Tech, 1998b).

Approximately 16 tons of debris (including materials coated with lead-based paint) were removed and properly disposed at Azusa Land Reclamation. A total of 112 tons of broken concrete were removed and transported to Service Rock Products in Barstow, California, for recycling. Guy wire cable totaling 42 tons was removed and transported to American Metal Recyclers (AMR) in Ontario, California, for recycling (Tetra Tech, 1998b).

The floor and trenches in the bunker generator room were oil-stained beneath the former generator locations. These areas were scraped clean of oil, and cleaned with a citrus-based solvent. The trenches were filled to grade with pea gravel Removed material was placed with stockpiled soil from other excavation/removal activities performed at the site (Tetra Tech, 1998b).

Underground Storage Tank Removal. The following paragraphs detail site investigations and removal actions in relationship to former USTs at the Hawes Facility. UST removal actions were conducted by Tetra Tech, Inc , in 1995 and by CKY, Inc., in 1996

<u>Oil Tanks</u> Two 700-gallon USTs along with product lines and concrete support slabs from the west side of the bunker were removed in October 1995 by Tetra Tech, Inc (Tetra Tech, 1998b). Residual sludge and liquids were removed from the tanks, and the tanks were cleaned on site. The tanks were then transported to AMR for recycling. A total of 160 tons of petroleum-stained soils were removed from beneath the tank and product lines. The soil was stockpiled on site for later characterization and disposal. Following excavation, soil samples were collected from the floor and walls of the excavation The excavation was then backfilled with pea gravel and covered with native soil (Tetra Tech, 1998b)

Analytical results from soil samples indicated residual contamination was present in the northeast and southeast sidewalls of the excavation and beneath the south tank concrete slab The volume of hydrocarbon-affected soil in excess of 1,000 mg/kg TPH was estimated at 500 cubic yards. CKY, Inc., re-excavated the backfilled tank cavity in April 1996 to remove the remaining contaminated soil. Approximately 353 cubic yards (135 tons) of contaminated soil were removed, transported to March AFB for disposal in the lined waste cell at IRP Site 6. Confirmation soil samples were collected and analyzed for total recoverable petroleum hydrocarbons (TRPH), TPH, aromatic hydrocarbons, and halogenated volatile organics Sample results indicated only TRPH (430 mg/kg) and TPH as diesel (716 mg/kg) were present in three samples. No other analytes were detected (Tetra Tech, 1998b and CKY, 1996).

<u>Water Tanks</u>. Two 10,000-gallon water tanks were removed from the sides of the bunker during October 1995. Approximately 5,000 gallons of water was removed from each tank and pumped onto an area of bare ground about 150 feet from the bunker. The tanks were transported to AMR for recycling. Two soil samples were collected from beneath each tank and analyzed for cadmium, chromium, lead, nickel, zinc, VOCs, and TPH. Elevated levels of TPH (2,210 mg/kg in the oil range) were reported from the southeast end of the excavation. The elevated TPH is possibly due to the asphaltic coating covering the tanks. Chromium, nickel, and zinc were found at relatively low concentrations, but cadmium and lead were not detected (Tetra Tech, 1998b).

<u>Septic Tank</u> A concrete septic tank, concrete distribution box, and four concrete leaching wells were excavated and exposed in October 1995. The leaching wells were 4 feet in diameter and 35 feet deep. One of the wells was completely filled with soil, one was filled with soil to within 2 feet of the top, and two wells were empty. The septic tank, distribution box, and leaching well lids were removed and transported to Service Rock Products for recycling. The two empty wells were filled with concrete slurry, and the excavation was filled with native material to grade and compacted (Tetra Tech, 1998b).

Ten soil samples were collected from the excavation and analyzed for cadmium, chromium, lead, nickel, zinc, VOCs, and TPH. Results showed one sample with elevated TPH (46 mg/kg in the oil range) and two samples with elevated TPH (2.4 and 2.1 mg/kg in the diesel range). Chromium, nickel, and zinc were found at relatively low concentrations, but cadmium and lead were not detected (Tetra Tech, 1998b).

Diesel Tanks. Eight slant borings were installed at a 30° angle from vertical to collect soil samples from beneath the two 50,000-gallon diesel USTs during October 1995. The soil samples were analyzed for VOCs, TPH, and organochlorine pesticides/PCBs. Acetone and methyl ethyl ketone (MEK) were detected in some samples, but are considered laboratory contaminants due to their reported presence in the method blank. TPH concentrations of up to 11 mg/kg (diesel) were detected in samples collected from the southern end of the tank excavation (Tetra Tech, 1998b)

The access vaults were also removed at this time and transported to Service Rock Products for recycling. Stained soils were observed at the bottom and in the sidewalls near the north and center vaults of the west tank, most probably originating from observed holes in the product lines (Tetra Tech, 1998b).

CKY, Inc., excavated and removed the two USTs during March 1996. Approximately 500 gallons of residual fuel were removed from the tanks and product lines, and transported to the Demenno/Kerdoon recycling facility in Compton, California. The tanks were cleaned on-site, and transported to AMR for recycling. Approximately one ton of product lines were transported to Fontana, California, to be cleaned, then transported to AMR for recycling. Approximately 1,300 tons of contaminated and potentially contaminated soils from the excavation were transported to March AFB and disposed in the lined waste cell at Site 6 (Tetra Tech, 1998b and CKY, 1996)

CKY collected soil samples from the floor and sidewalls of the excavation. These samples were analyzed for TRPH, TPH, and aromatic hydrocarbons. Two samples that had a fuel-like odor were analyzed for halogenated volatile organics. Based on results of these analyses, the tank excavation was over-excavated and re-sampled. Residual contamination of up to 13,000 mg/kg at 28 feet bgs was identified in the southern portion of the excavation (Tetra Tech, 1998b and CKY, 1996).

The RWQCB requested that a subsurface investigation be conducted in this area to assess the horizontal and vertical extent of contamination. Three vertical boreholes were installed on May 8, 1996 to 40 feet bgs in the area. A reported regional hardpan was encountered in the boreholes at about 35 to 40 feet bgs that consisted of a well-cemented sandy soil. Beneath this layer, sand extends to a perched water table encountered in surrounding sites at 100 to 150 feet bgs Soil samples from each borehole were collected from 15, 20, and 25 feet bgs. Analysis of these samples for TPH reported results less than the reporting limit of 2.5 mg/kg in all samples, indicating the extent of contaminated soil is localized at the southern end of the excavation Estimates of the amount of residual contaminated soil was about 220 cubic yards (Tetra Tech, 1998b and CKY, 1996)

Stockpile Sampling. The following paragraphs detail stockpile sampling in 1995 and 1996.

Stockpiles (1995). The soils removed from each excavation were segregated into individual stockpiles for proper characterization and disposal. Composite soil samples were analyzed for cadmium, chromium, lead, nickel, zinc, TPH, and VOCs. Results indicate relatively low concentrations of chromium, lead, nickel, and zinc, but no cadmium was detected. TPH results of up to 2,300 mg/kg (diesel) and 4,100 mg/kg (oil) were reported. Soils were transported to the McKittrick facility for treatment (Tetra Tech, 1998b)

Stockpiles (1996). Soils removed from the oil tank and diesel tank excavations were stockpiled on site for characterization and disposal. Samples collected from the stockpiles were analyzed for TRPH, TPH (diesel), and aromatic hydrocarbons. TRPH results of up to 11,999 mg/kg and TPH of up to 13,000 mg/kg were reported. Stockpiled soils were then transported to March AFB and disposed in the Site 6 disposal cell (Tetra Tech, 1998b and CKY, 1996).

Site Restoration. Site restoration was performed in May 1996. All excavated areas were backfilled with clean soils to grade, as approved by the County of San Bernardino Department of Environmental Health Services (DEHS) and the RWQCB. Cavities were backfilled in loose lifts of 8 inches or less in thickness. Each lift was compacted to at least 90 percent of the maximum dry density prior to addition of the next lift (Tetra Tech, 1998b)

Remaining debris (household trash and concrete) and transite pipe were transported and properly disposed. Debris was disposed of at the Crosby and Overton facility in Long Beach, California. Transite pipes were disposed at the BBK landfill in West Covina, California (Tetra Tech, 1998b).

Tortoise Monitoring. Tortoise-proof fencing during site activities was determined to be impractical due to the large areas impacted, amount of heavy equipment used, and large number of persons at the site. Tortoise monitoring during all site activities was performed, and no encounters with tortoises were reported during these activities (Tetra Tech, 1998b).

3.3.1.2 Previous Recommendations.

Based on investigations performed by Tetra Tech, Inc., and CKY, Inc., the Air Force recommended closure and NFA at the site. The Air Force received a "Case Closure" letter from the RWQCB, Santa Ana Region pertaining to the UST closures in October 1996.

3.3.2 OU4 RI Investigation

The OU4 investigation reviewed the existing data and summarized that information into this report. The objective is to codify the removal actions in the OU4 ROD and proceed with final demolition of all remaining facilities at the site.

3.3.2.1 OU4 Objectives.

The objectives are to summarize the findings from the Tetra Tech and CKY investigations and formalize the recommendations.

3.3.2.2 Review of Field Activities.

There were no field activities at Site 41 during the OU4 RI.

3.3.2.3 Variations from the Work Plan.

This site was not included in the original Work Plan The work conducted during this investigation included a literature review and analysis of the existing information.

3.3.2.4 Summary of Laboratory Methods.

No samples were collected, and no laboratory analyses were conducted for this site.

3.3.3 Physical Site Conditions

The Hawes Radio Relay Station is located in a remote area of the Mojave Desert, approximately 1 mile south of State Highway 58, and 11 miles east of Kramer Junction (intersection of State Highway 395 and State Route 58), in San Bernardino County, California. The site occupies portions of Township 10 North (T10N), Range 4 West (R4W), Section 30, and T10N, R5W, Sections 26 and 35, as shown on the Twelve Gauge Lake and Kramer Hills 15-minute USGS Quadrangles (USGS 1973a, 1973b).

The Hawes site extends across 315 acres of land in the Mojave Desert Geomorphic Province as defined by Norris and Webb (1990) The province is distinguished by low hills composed of Paleozoic and lower Mesozoic rocks, separated by broad alluvial valleys. The Mojave Province is cut by a series of northwest-trending faults. Two of these faults (the Helendale and the Lockhart faults) extend to within a few miles on each side of the site The northernmost end of the Helendale fault is shown to extend approximately 2 miles to the northwest of the site boundary and is shown to displace Quaternary alluvium indicating relatively recent activity. Depth to beneficial groundwater is approximately 300 feet as measured in the on-site well and inferred from geophysical data. However, perched zone water is found between 100 and 150 feet bgs at nearby sites (CKY, Inc. 1996)

3.3.3.1 Surface Features.

The relay station was built on relatively flat topography at an elevation of approximately 2,500 feet above MSL. The overall topographic slope is gentle and to the northeast. There are a few natural gullies and man-made drainages, ranging in depth from 2 to 4 feet. The surface gradient at the site is approximately 20 to 40 feet per mile to the northeast. Topographically, the area consists of well dissected alluvial fans draining northeast towards Highway 58.

3.3.3.2 Stratigraphy.

The stratigraphy of the area is typical of alluvial fan deposits in arid terranes. Soils are dominated by silty sands and sands based on boreholes installed by CKY during the removal of USTs at the site in 1995 and 1996 (CKY, 1996). The soil is well cemented at about 35 to 40 feet bgs, resulting in very hard drilling. A regional hardpan soil, approximately 3 to 4 feet thick at a depth of 35 to 40 feet bgs is reported in the area. Beneath this layer, the sand continues to a perched water table that was encountered at nearby sites at 100 to 150 feet bgs (CKY, Inc., 1996). Bedrock exposures are present approximately 1.5 miles west of the site and approximately 1 mile to the southwest.

3.3.3.3 Groundwater.

Perched groundwater exists beneath the site at approximately 100 to 150 feet bgs. Depth to beneficial groundwater is approximately 300 feet bgs as measured by the former on-site production well and inferred from geophysical data.

Until October 1995, the Hawes Site received its water from an on-site production well. On October 4, 1995, the well was destroyed per State of California and San Bernardino County well abandonment requirements (Tetra Tech, 1998b).

Prior to well destruction, an inspection of the water supply well was conducted. Upon opening the well lid, the 1-inch diameter riser pipe that suspended the well pump had separated at the first coupling (20 feet below the top of casing [TOC]) due to corrosion. Approval to leave the pump in the well was obtained from the County of San Bernardino DEHS (Tetra Tech, 1998b).

The well was video surveyed and gamma logged. The top of the 1-inch riser pipe was 136 feet below TOC, and water was 303 feet below TOC. Logging activities encountered an obstruction or the well bottom at about 470 feet below TOC. Several attempts to collect a water sample were thwarted as the rope suspending the sample bailer continued to snag on the top of the 1-inch riser pipe. Both the County of San Bernardino DEHS and the RWQCB agreed not to require sampling of the well prior to destruction (Tetra Tech, 1998b).

The well was destroyed in October 1995 by filling the well with pea gravel to a depth of 92 feet below TOC, native soil to a depth of 25 feet below TOC, and concrete slurry from 25 feet below TOC to grade (Tetra Tech, 1998b).

3.3.4 Nature and Extent of Contamination

Remaining site contamination is limited to residual diesel hydrocarbon in soils at the southern end of the former diesel UST location. Residual contamination is documented in the Site Closure Report prepared by Tetra Tech (1998b).

3.3.4.1 Soil Contamination.

The extent of soil contamination remaining at the site is limited to low levels of diesel contamination in soil below 20 feet bgs. The estimated extent of impacted soil is limited to the southern portion of the former diesel tank UST excavation (maximum concentration in one soil sample from 28 feet bgs was 13,000 mg/kg TPH as diesel). Additional boreholes installed to define the lateral and vertical extent of contamination showed that the elevated TPH values are limited in extent All 18 of the samples collected from three soil borings did not have TPH concentrations above the reporting limit of 2.5 mg/kg, thus indicating that the extent of contamination in the subsurface is limited in extent and did not extend far beyond the south wall of the excavation. CKY, Inc. (1996), estimated approximately 220 cubic yards of contaminated soil remained at the site.

3.3.4.2 Groundwater Contamination.

No groundwater contamination was identified in water from the production well located on site. The former groundwater production well that supplied water to the facility was destroyed in October 1995.

3.3.4.3 Site Characterization Summary.

Residual contamination is present in the subsurface soil as a result of leaking USTs that were present at the site. The estimated extent of impacted soil is limited to low levels of TPH diesel contamination in the area of the former UST locations. CKY estimated approximately 220 cubic yards of contaminated soil remain at the site at depths between 28 and 35 feet bgs.

3.3.5 Potential Migration Pathways

Residual diesel contamination of soils at depths of over 20 feet bgs at the southern end of the diesel UST excavation has a limited probability for transport due to the following reasons:

- Contamination is limited to subsurface soils at depths greater than 20 feet; therefore not a concern with respect to direct exposure to human and ecological receptors

- Remote location of the site and future land use as a natural habitat

- Low possibility of impact to beneficial groundwater (at 300 feet bgs) due to:

    - Low mobility of contaminants identified

- Presence of low-permeability soil layer at about 34 feet bgs

- Low surface water percolation rates due to low local precipitation and high evaporation rates.

For these reasons, remaining site contamination does not threaten natural resources, and transport mechanisms are not of concern at the site (Tetra Tech, 1998b)

3.3.6 Risk Assessment

No formal risk assessment was required for this site. Hydrocarbon impacted soil remains at the site at depths greater that 20 feet bgs. The naturally occurring hard pan identified in soil borings at 35 to 40 feet bgs act as a natural barrier to the transport of hydrocarbon impacted soil to the aquifer located at greater than 300 feet bgs. In addition, the arid climate (low annual precipitation and high evaporation rates) at the site limits the migration of contamination at depth. Therefore, the residual fuel-related contamination present at the site does not pose a threat to the groundwater in the area.

3.3.7 Conclusions

The Air Force completed removal of all infrastructure, abandonment of the water well, and excavation of contaminated soils associated with the various USTs between February 1995 and April 1996. Based on results from these investigations and subsequent remedial activities, site closure was recommended for the following reasons (Tetra Tech, 1998b):

- A NFA letter was issued by the RWQCB Santa Ana Region on 17 October 1996. The closure letter addresses the site investigation and remedial action for the former USTs.

- Preliminary closure notification has been received from the Department of Toxic Substances Control (DTSC) and U.S. EPA Region IX.

- The only remaining structures are the aboveground bunker and the airfield.

- All identified underground structures have been removed, and the former water supply well has been destroyed.

- ACM, materials containing lead-based paint, and trash and debris have been removed from the site.

- Most of the soils contaminated with hydrocarbons have been removed.

The remaining hydrocarbon-contaminated soil in place in the southern portion of the former diesel tank excavation is not considered a threat to human health, the environment, or groundwater for the following reasons (Tetra Tech, 1998b):

- Contamination is limited to subsurface soils at depths greater than 20 feet and is therefore not a concern with respect to direct exposure to human and ecological receptors.

- The remote location of the site and future land use as a natural habitat limit the exposure pathways.

- There is a low possibility of residual soil contamination impacting beneficial groundwater (at 300 feet bgs) due to:

  - Low mobility of contaminants identified

  - Presence of low-permeability soil layer at about 34 feet bgs

  - Low surface water percolation rates due to low local precipitation and high evaporation rates.

  - Depth to beneficial groundwater is in excess of 300 feet bgs

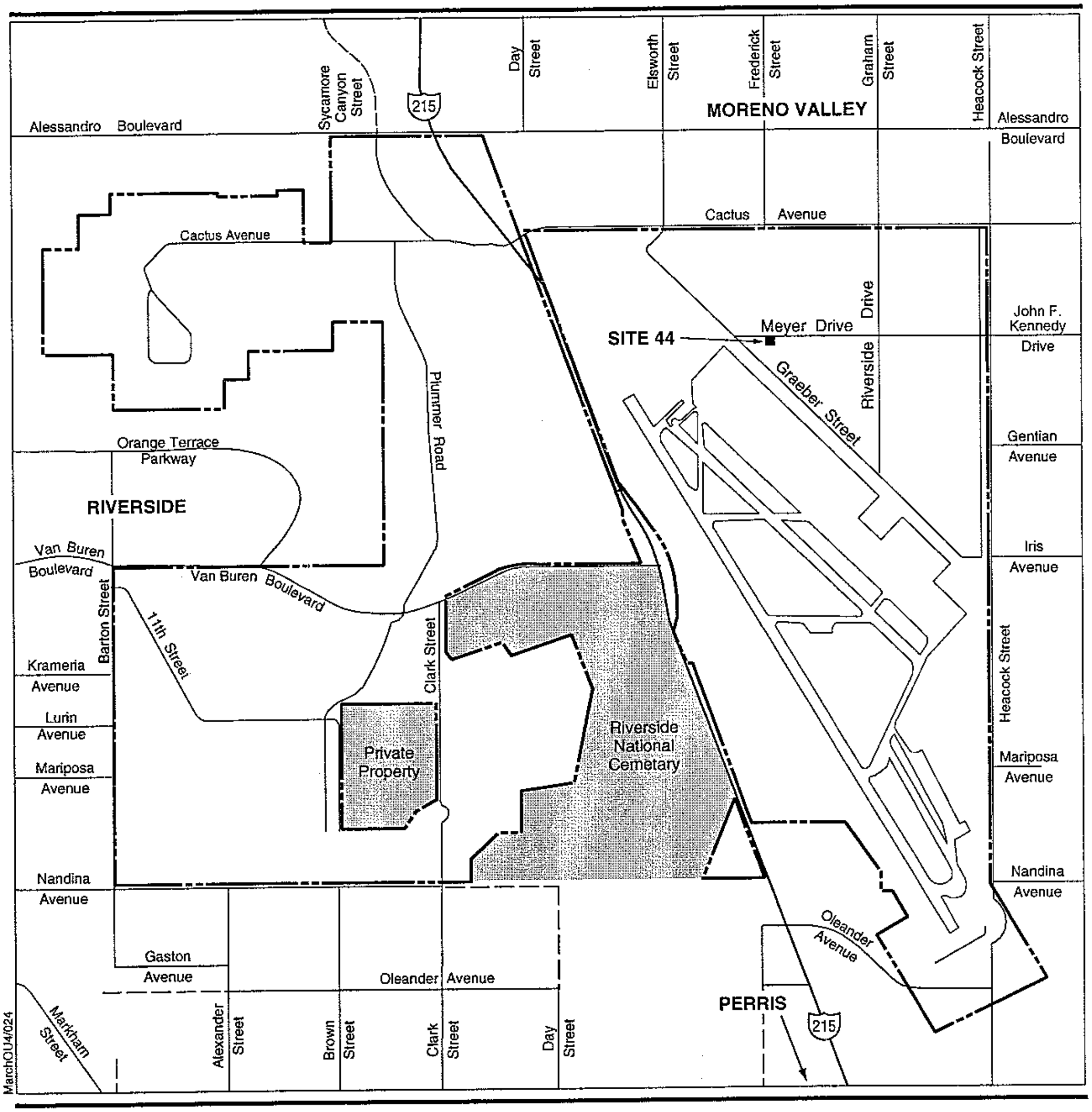
3.3.8 Recommendations

The Hawes Site is recommended for NFA. In the closure document (Tetra Tech 1998b), the regulatory agencies agreed that NFA was necessary at the site. At the request of the BLM, the Air Force will remove all concrete and asphalt to 6 feet bgs at the site This includes an earth-covered concrete bunker, paved areas, concrete antenna anchors, barbed wire fencing, and miscellaneous debris remaining from prior removal activities. Excavated areas will be backfilled, and areas disturbed by demolition activities would be leveled and the soil scarified to a depth of 6 inches to relieve soil compaction. The Air Force has already completed an Environmental Assessment for the proposed action, and the document is final.

3.4 SITE 44

3.4.1 Site Background

IRP Site 44 is located east of Site 2 and east of the intersection of Graeber and Meyer Drives (Figure 3-6). Site 44 includes the 110-foot tall, 200,000-gallon Water Tower 407, two large water storage tanks, and several buildings used by March ARB water system maintenance personnel. IRP Site 44 (Water Tower 407) utilized a valve controller with a 6-inch mercury pot for water flow control. Past spills from the mercury pot caused contamination of soils beneath and surrounding the valve controller, as confirmed by investigative actions. The flow controller at Water Tower 407 was located in a subsurface valve box 12 feet below grade During a construction project to place a concrete floor in the below-grade valve box, approximately 80 cubic feet of soil were removed from the



EXPLANATION

------ Former AFB Boundary

Site 44 Location Map March ARB

0 900 1800 3600 Feet

Figure 3-6

bottom of the valve box and stockpiled south and east of the valve box In November 1995, March AFB contracted with Quaternary Investigations, Inc , to characterize the valve box and surrounding area for mercury contamination. Based on the results of initial investigations at Site 44, a remedial action was initiated by March AFB/ARB

3.4.1.1 Previous Investigations

The initial investigation conducted by Quaternary Investigations, Inc., in 1995 collected 273 soil samples from various locations within and near the valve box. No soil was removed at this time. IT Corporation was contracted through the USACE to provide a Rapid Response Removal Action at the site. The goal was to remove mercury-contaminated soil from the site to levels that would be protective of groundwater and to protect workers that visit the site. In March 1997, remedial actions were begun at Site 44 by IT Corporation.

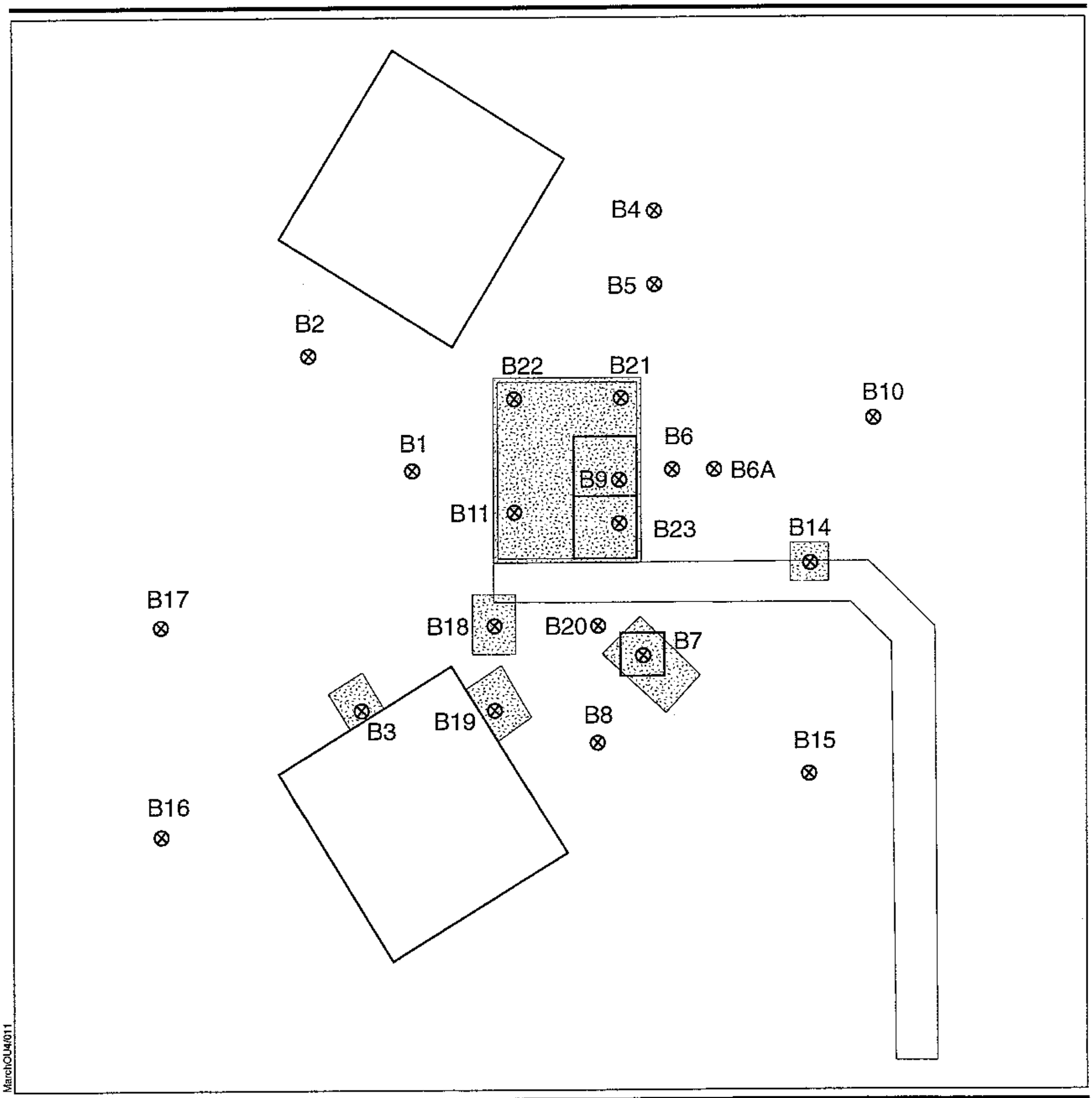
Excavation Procedures. IT excavated the water tower area in accordance with the approved work plans. This included the excavation of several discrete areas around the water tower and proper disposal of the contaminated soil The primary soil removal areas were the valve box (Borings B9 and B23), and the shallow soil areas near Boring B3 (Boring B14, B19, and Boring B7) (Figure 3-7) In addition, surface soils were excavated in areas adjacent to the other borings to remove "hot spots" of contamination. The excavated soil was segregated and packaged for off-site disposal.

The soil from the valve pit was excavated by hand, using electric spades and buckets. Excavation activities began by erecting a hoist stand over the valve pit and attaching an electric chain hoist to the stand. The soil was excavated and placed into 10-gallon plastic tubs, which were hoisted out of the pit. The tubs were then moved to a testing area where the soil was screened with an X-ray Fluorescence (XRF) meter and dumped into the appropriate storage container (segregating visually contaminated soil from soil that was not visually contaminated). After removal of the muddy soil, the excavation was extended further into the native soil at the bottom of the valve pit The valve pit excavation was extended down to 20 feet below grade in a 3-foot by 6-foot area surrounding borings B-9 and B-23. Borings B-11, B-21, and B-22 were halted at 19 feet bgs. Boring locations are shown on Figure 3-7.

Surface Soil Excavation. Soil contamination outside of the valve box was excavated with a backhoe and by hand in approximately 3-foot by 3-foot areas. Table 3-7 shows the areas that were excavated and the depths indicated:

Table 3-7. Site 44 Surface Soil Excavation Table

Boring	Depth (Feet)	Width (Feet)	Length (Feet)
B3	4	3	3
B7	11	3	6
B14	3	5	3
B18	2	3	3
B19	2	3	3



EXPLANATION

⊗ Soil Borings

Excavations

IRP Site 44
Soil Boring

Figure 3-7

The soil from Boring B-7 (Table 3-7) was excavated with a backhoe/loader. All other borings were excavated by hand The waste soils were properly characterized and disposed.

Sample Collection and Analysis. Samples were collected in accordance with the *Chemical Sampling and Analysis Plan* (IT Corporation, 1996). The XRF meter was used to screen the soil prior to sending a sample for off-site analysis. This greatly reduced the number of samples requiring analysis by an off-site laboratory. All confirmation samples and waste characterization samples were shipped off-site to V.O.C Analytical Laboratory of Glendale, California, for mercury analysis using EPA Method SW7471 and for moisture, following proper COC requirements outlined in the IT Corporation Work Plan (1996).

Soil screening at Site 44 was conducted throughout soil excavation operations The first soil screening samples were selected randomly from the area underneath the water tower. These samples were analyzed by the contracted off-site analytical laboratory to verify the accuracy and precision of the XRF instrument. The XRF instrument was used to help guide the total depth of excavation Following excavation, confirmation samples were then collected from the bottom and sides of each excavation These samples were shipped off-site for laboratory analysis.

In addition to the soil screening samples and the confirmation samples, soil samples were collected for waste characterization. Samples were collected from each roll-off bin and from each 55-gallon soil drum. These samples were shipped off site for analysis by the contracted analytical laboratory.

Site Restoration. Once excavation of the valve pit was completed, the site was restored by filling the excavation with sand (as the shoring was removed) to approximately 3 feet below the valve. A 6-inch thick concrete floor was installed in the bottom of the valve pit. Two valve stands were installed under the valve and the access ladder was repaired. Surface soil excavation areas were backfilled with native soil and compacted with the backhoe bucket.

3.4.1.2 Previous Recommendations.

Site 44 was remediated in accordance with the approved work plan (IT Corp, 1996). Confirmation samples collected in the valve pit indicated that soil remaining in the side walls and bottom of the excavation contained residual mercury concentrations below the remediation goals established by IT Corporation prior to beginning work (>1 mg/kg mercury). For excavations conducted outside the valve pit, residual contamination is below the 70 mg/kg cleanup criteria established for soil outside the valve pit (IT Corporation, 1997) Per IT Corporation's work plan, the remediation goals had been achieved. At the completion of the soil removal action, the regulators requested groundwater monitoring in monitoring wells surrounding the site.

3.4.2 OU4 RI Investigation

The following sections detail OU4 objectives, review OU4 field activities, describe variations from the work plan, and summarize laboratory methods.

3.4.2.1 OU4 Objectives.

The purpose of the investigation at Site 44 was to evaluate potential threats to human health posed by past spills of mercury.

3.4.2.2 Review of Field Activities.

In 1997, IT Corporation excavated and removed mercury-contaminated soil from the valve pit area and from shallow surface soil locations beneath Water Tower 407. The removal action was conducted in accordance with the Mercury Spill Clean Up Work Plan (IT Corporation, 1996). Mercury-contaminated soil was removed by hand from the valve pit and the soil was excavated and placed into 10-gallon plastic buckets and hoisted out of the pit. The excavated soil was screened with an XRF meter and segregated into contaminated versus non-contaminated bins for disposal. Surface and shallow subsurface soil was removed from areas beneath Water Tower 407 using a backhoe and shovels (hand). Once the mercury-contaminated soil had been removed, confirmation samples were collected and screened with the XRF. If the sample showed that the level of mercury contamination was below the cleanup criteria, the sample was sent to the laboratory for confirmation and excavation ceased. If the sample showed levels of mercury above the cleanup criteria using the XRF, additional soil was removed until sampling and screening with the XRF showed the cleanup goals had been achieved. Once mercury had been removed to acceptable levels, the site was restored by filling the excavation with sand in the valve pit and with native soil in the other excavations. A 6-inch-thick concrete floor was installed in the bottom of the valve pit.

Excavation and off-site disposal of mercury-contaminated soils effectively remediated the site to target cleanup levels. Confirmation samples collected at Site 44 confirmed the reduction in mercury contamination to clean up levels established in the Mercury Spill Clean Up Work Plan prepared by IT Corporation (1996)

3.4.2.3 Variations from the Work Plan.

Site 44 was remediated in accordance with the work plan dated 30 October 1996 (IT Corporation) There were no deviations from the work plan noted. All work at Site 44 was conducted in accordance with the site-specific work plans prepared for the site.

3.4.2.4 Summary of Laboratory Methods.

Confirmation soil samples were analyzed for mercury using EPA Method 7471 (IT Corp, 1997).

3.4.3 Physical Site Conditions

Site 44 is located on the Main Base, just east of the intersection of Meyer Drive and Graeber Street near the March Inn. The site is located in the NW ¼ of the NW ¼ of Section 24, T3S, R4W of the San Bernardino Base Meridian, in the Riverside East 7½ minute quadrangle (USGS, 1967b).

3.4.3.1 Surface Features.

Site 44 is approximately 1,535 feet above MSL in the east-central portion of the Main Base, in an area characterized by relatively flat topography. A concrete-lined drainage ditch, located just north of the site, flows eastward to the Heacock Storm Drain that drains south along the eastern perimeter of the former base.

3.4.3.2 Stratigraphy.

No specific stratigraphic information is available for Site 44. However, Site 2 is located immediately west of the site. Borehole data from numerous borings installed at Site 2 indicate that the area is underlain by alternating layers of silty sand and sandy silt to a depth of approximately 190 feet. Occasional thin, discontinuous lenses of clean sand and clay are also present, but are not laterally continuous. The finer grained sediments often produce local confining layers in the aquifer. Depth to bedrock at Site 2 is approximately 190 feet bgs.

3.4.3.3 Groundwater.

Depth to groundwater in the area of Site 44 is estimated to be about 30 feet bgs. Groundwater flow direction in this area is generally to the south and southeast based on water level measurements at Site 2. Due to mercury contamination at Site 44, the regulatory agencies requested that the groundwater monitoring wells immediately surrounding the site be sampled and analyzed for mercury to determine if soil contamination has resulted in elevated levels of mercury in groundwater.

3.4.4 Nature and Extent of Contamination

The following sections define the nature and extent of the constituents identified during site investigations at Site 44.

3.4.4.1 Soil Contamination.

Elevated concentrations of mercury were detected in soils at Site 44 in 1995. In 1997, IT Corporation excavated and removed elevated concentrations of mercury in soils at Site 44. Results of confirmation samples taken after the excavation and removal indicate that the elevated concentrations of mercury have been removed (Table 3-8). One sample located near Boring B14 had a mercury concentration of 270 mg/kg. However, a second sample collected immediately below that sample had a concentration of 1.8 mg/kg. IT Corporation concluded that site contaminants have been remediated to approved clean-up levels (specifically, 1 mg/kg within the valve box and 70 mg/kg in all locations).

Table 3-8. Site 44 Confirmation Sample Results

Sample Location	Near Boring Number	Sample Number	Mercury Result Method SW 7471 (mg/kg)
	B-18	MAFBMS-SC001-250397	4.2
		MAFBMS-SC002-250397	20
		MAFBMS-SC003-250397	0.94
		MAFBMS-SC004-250397	2
		MAFBMS-SC005-250397	0.34
	B-19	MAFBMS-SC006-250397	0.14
		MAFBMS-SC007-250397	0.16
		MAFBMS-SC008-250397	0.091
		MAFBMS-SC009-250397	<0.1
	B-3	MAFBMS-SC010-250397	<0.1
		MAFBMS-SC011-250397	<0.1
		MAFBMS-SC012-250397	<0.1
		MAFBMS-SC013-250397	<0.1
	B-14	MAFBMS-SC014-250397*	270*
		MAFBMS-SC015-250397	2.6
		MAFBMS-SC016-250397	0.26
		MAFBMS-SC017-250397	0.082
		MAFBMS-SC018-250397**	1.8**
Valve Box and Immediate Area	B-9, B-11, B-22, and B-23	MAFBMS-SC021-250397	0 31
		MAFBMS-SC022-260397	0.43
		MAFBMS-SC023-270397	<0.1
		MAFBMS-SC024-270397	<0.1
		MAFBMS-SC025-270397	<0.1
		MAFBMS-SC026-270397	<0.1
		MAFBMS-SC027-270397	<0.1
		MAFBMS-SC028-270397	<0.1
		MAFBMS-SC029-270397	<0.1
		MAFBMS-SC030-270397	<0.1
	B-7	MAFBMS-SC031-310397	0.32
		MAFBMS-SC032-310397	<0.1
		MAFBMS-SC033-310397	5.7
		MAFBMS-SC034-310397	<0.1
		MAFBMS-SC035-310397	<0.1
		MAFBMS-SC036-310397	0.72
		MAFBMS-SC037-310397	<0.1
		MAFBMS-SC038-310397	<0.1
		MAFBMS-SC039-310397	0.74
		MAFBMS-SC040-31-0397	1.4

Notes: * Sample depth at 6 inches
** Sample depth at 12 inches

3.4.4.2 Groundwater Contamination.

Elevated concentrations of mercury were detected in soils at Site 44. In accordance with the Work Plan, site contaminants were remediated to levels at or below 1 mg/kg within the valve box and 70 mg/kg in all other locations. The clean up criteria of 1 mg/kg inside the valve box and 70 mg/kg for surface soil outside the valve box was shown to be protective of groundwater and of workers who would visit the site (IT Corp, 1997) Appendix I of the *Final Report, Mercury Spill Cleanup ay Site No. 44, Water Tower No. 407, and Soil Excavation at Site No. 8, Area 17, March Air Reserve Base, California* (IT Corp., 1997) outlines and contains all of the assumptions used in the VLEACH model used by IT Corporation

Due to regulatory concerns, groundwater samples were collected from groundwater monitoring wells that surround the site to determine if mercury contamination from Site 44 impacted groundwater beneath the site (Figure 3-8). From Summer 1996 through Winter 1997, a limited groundwater investigation was conducted for mercury by Tetra Tech (IT Corporation, 1997). Table 3-9 lists the Site 2 monitoring well data for the monitoring wells adjacent to the water tower. The analytical data indicates that mercury is present in the groundwater in the area adjacent to the water tower. The Santa Ana Regional Water Quality Control Board (RWQCB) cleanup objective for mercury is 0.002 mg/L. As shown in Table 3-9, with the exception of monitoring well 5M2MW1, mercury concentrations in all of the sampled wells where mercury was detected have been declining over time. Mercury concentrations for monitoring well 5M2MW1 are slightly higher than the Santa Ana RWQCB cleanup objective and the U.S. EPA and California Maximum Contaminant Level (MCL) of 0.002 mg/L.

Table 3-9. Mercury Analysis at Site 2

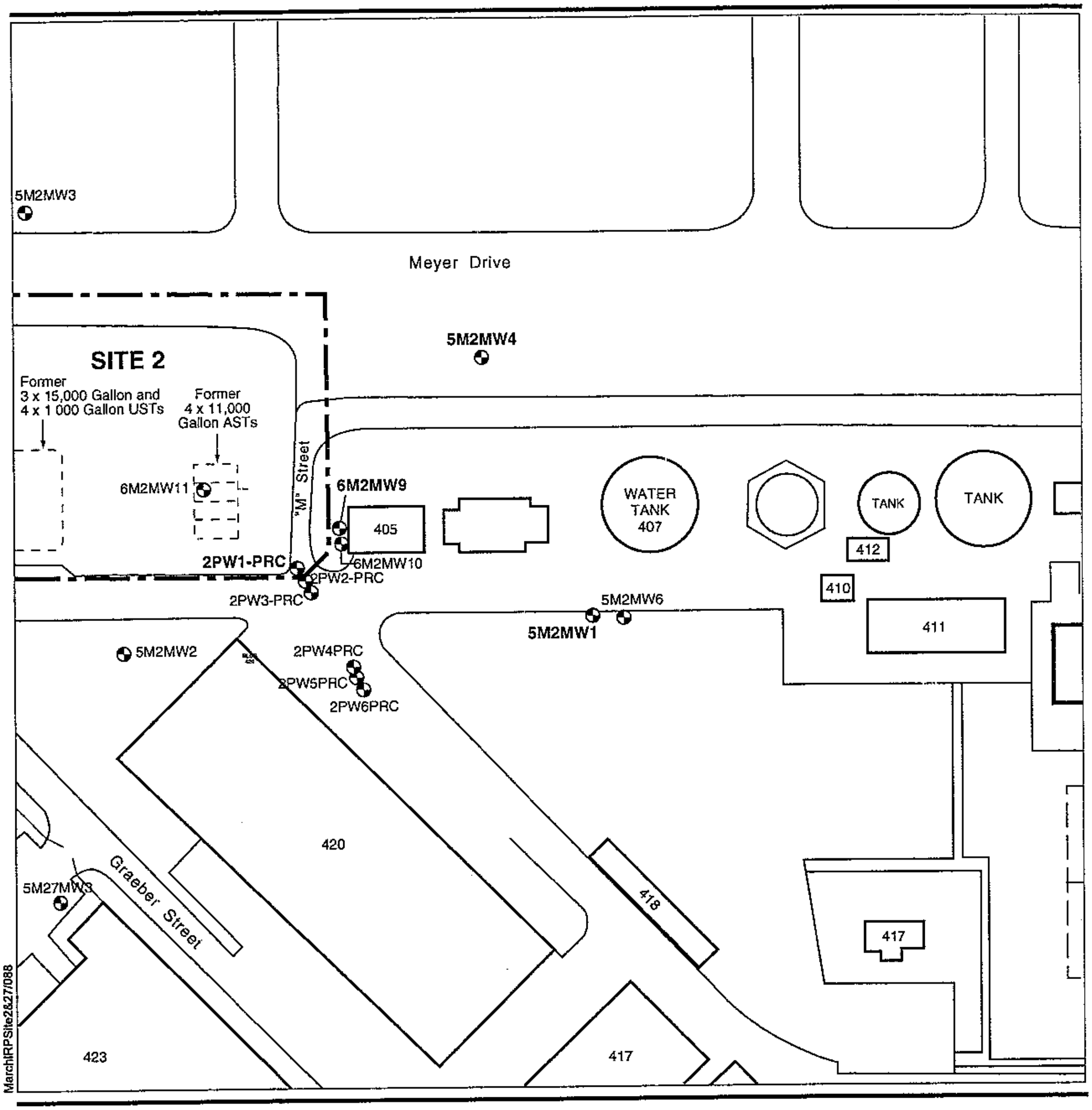
Well Identification Number	RWQCB Cleanup Objective (mg/L)	Summer 1996 (mg/L)	Fall 1996 (mg/L)	Winter 1996/1997 (mg/L)
2PW1PRC	0.002	Non-detect	0.0033	0.00011
5M2MW1	0.002	Non-detect	0.0021	0.0021
5M2MW4	0.002	Non-detect	0.00088	0.0003
6M2MW9	0.002	Non-detect	Non-detect	Non-detect

IT Corporation. 1997

Based on the analytical results from groundwater samples collected over three quarters, the regulators agreed that no additional groundwater sampling for mercury at the site was required. Transport mechanisms are not of concern at Site 44 (IT Corporation, 1997) Therefore, additional groundwater testing has not been conducted

3.4.4.3 Site Characterization Summary.

Previous investigations at Site 44 identified significant mercury contamination in site soils. In Spring 1997, soil excavation and off-site disposal of mercury-contaminated soil at Site 44 were conducted by the IT Corporation to remove elevated concentrations of mercury. Contaminated concrete, piping, and soils were removed via demolition and excavation. Contaminated soils were excavated, confirmation sampling was performed in the active excavation to determine the final excavation depth, and clean fill was placed in the excavation to original grade. All of the work was completed in accordance with the site-specific work plans. Analytical results from confirmation samples taken after the



EXPLANATION

Existing Monitoring Well

IRP Site 44 Monitoring Well Network

0 45 90 Feet

Figure 3-8

excavation was complete indicate that the elevated mercury concentrations have been removed to below cleanup standards established in the IT Corporation Work Plan (1996)

The confirmation samples (samples MAFBMS-SC023-270397 to MAFMBS-SC030-270397) in the valve pit indicate the soil remaining in the sidewalls and bottom of the excavation contains mercury contamination below the remediation goal of 1 mg/kg, established for the valve pit Also, the confirmation samples collected outside the valve pits (samples MAFBMS-SC001-250397 to MAFBMS-SC018-250397, MAFBMS-SC021-250397, MAFBMS-SC022-250397, and MAFBMS-SC031-310397 to MAFBMS-SC040-310397) indicate that the surface soil contains mercury concentrations at levels below the remediation goal of 70 mg/kg Analytical data are included in the *Final Report Mercury Spill Cleanup* (IT Corporation, 1997)

3.4.5 Potential Migration Pathways

Site contaminants have been remediated to levels at or below established levels defined in the work plan, (specifically, 1 mg/kg within the valve box and 70 mg/kg in all other locations) No transport mechanisms are therefore of concern at the site (IT Corporation, 1997).

3.4.6 Risk Assessment

A review of Table 3-8 shows that confirmation samples collected within the valve box (samples MAFBMS-SC023-270397 to MAFBMS-SC030-270397) were well below the remediation goal of 1 mg/kg. In addition, confirmation samples collected from other shallower excavations were below the cleanup goal of 70 mg/kg (samples MAFBMS-SC001-250397 to MAFBMS-SC018-250397, MAFBMS-SC021-250397, MAFBMS-SC22-250397, and MAFBMS-SC031-310397 to MAFBMS-SC040-310397).

All samples collected following remediation of the site were well below the residential PRG of 23 mg/kg, with the exception of MAFBMS-SC014-250397, which had a concentration of mercury at 270 mg/kg. A duplicate sample (MAFBMS-SC018-250397) collected immediately below the original sample had a concentration of 1.8 mg/kg well below the residential PRG of 23 mg/kg

3.4.7 Conclusions

Excavation and off-site disposal of mercury-contaminated soils effectively remediated the site to target clean-up levels Reduction in elevated mercury contamination has been confirmed by sample analysis. Confirmation samples collected following the removal action showed that residual mercury contamination did not exceed the residential PRG of 23 mg/kg. The duplicate sample collected immediately below the sample with 270 mg/kg and all surrounding samples showed that the sampled with the elevated mercury was an anomaly and that residual mercury contamination remaining at the site was below unrestricted levels Therefore, no further action is recommended at Site 44.

3.4.8 Recommendations

NFA is recommended for Site 44.

3.5 SITE L

3.5.1 Site Background

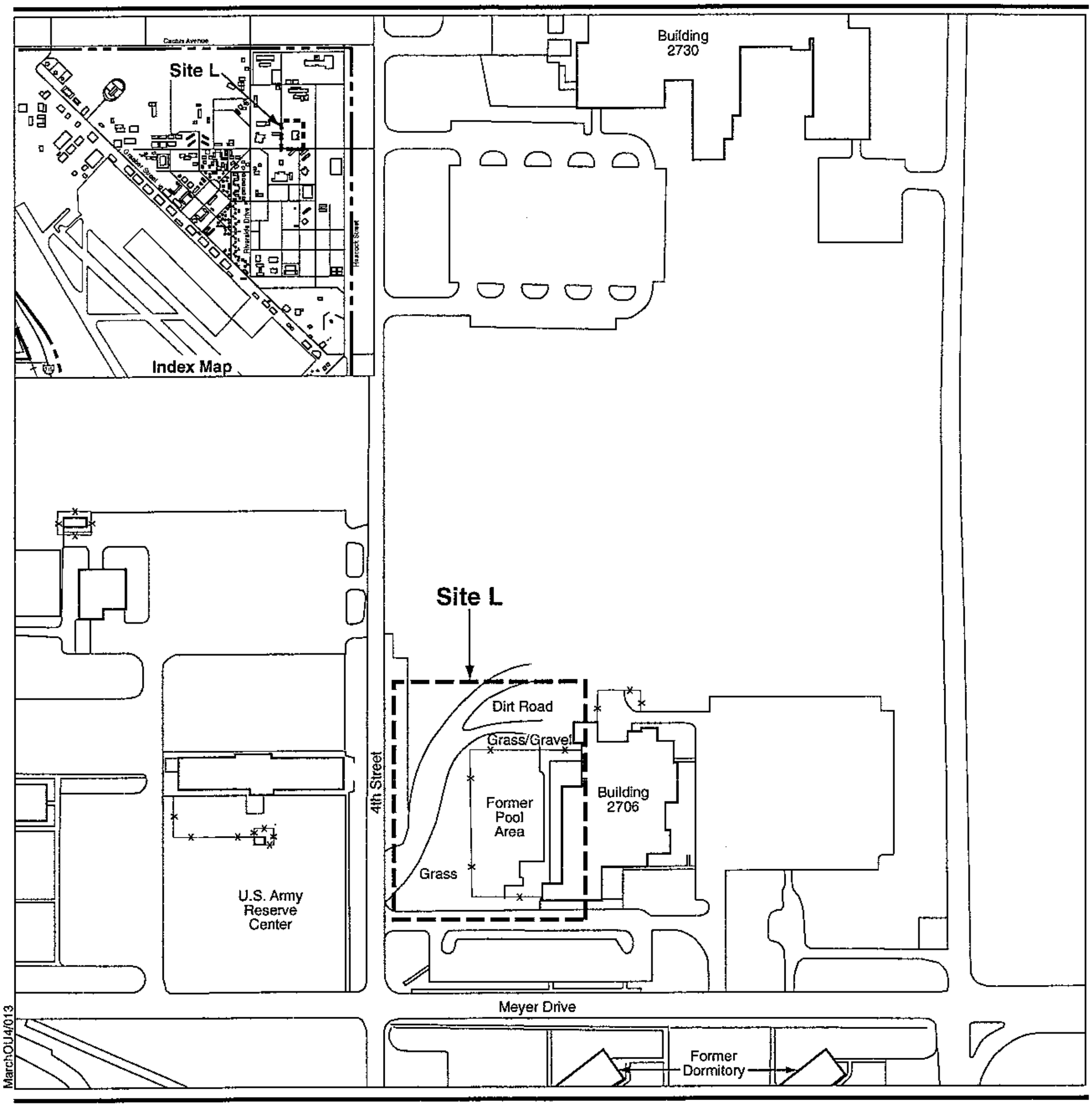
Site L was formerly a swimming pool at the Non-Commissioned Officers' (NCO) Club. The site is east of Riverside Drive and north of Meyer Drive in a sparsely developed area (Figure 3-9) The site is surrounded on the north by vacant land and is bordered on the south by a parking area adjacent to Meyer Drive. The NCO Club (Building 2706) is to the east and the U.S. Army Reserve Center with associated landscaping and parking is to the west. The few large buildings in the site vicinity include a series of former dormitory buildings along the south side of Meyer Drive, the U.S. Army Reserve Center on the west side of 4th Street, and the communications complex to the north. The Site L area is located outside the boundary of March ARB that was established as a result of the realignment of March AFB in April 1996. It is part of the land identified as available for transfer by the Air Force Real Property Agency (AFRPA)

Site L was reportedly constructed in 1953 along with the NCO Club. After decommissioning at an unspecified time, the swimming pool was used as a repository for a variety of wastes, some potentially hazardous. The area between and above the waste in the pool was filled with soil, and the area was allowed to become overgrown with grass and weeds. The facility was abandoned, and a chain-link fence restricted access to the former pool.

3.5.1.1 Previous Investigations.

From 1993 to 2000, several investigations, removal actions, and mitigation efforts were conducted intermittently at Site L. These are summarized in the following paragraphs.

RCRA Facility Assessment/Expanded Source Investigation (RFA/ESI). In 1993, the pool was identified as an area of concern (AOC) during a comprehensive RFA/ESI. The RFA/ESI was conducted by Earth Tech (formerly The Earth Technology Corporation) on behalf of the Air Force Center for Environmental Excellence (AFCEE) to determine what materials were disposed of in the pool and the actual location of the pool. The RFA/ESI Report concluded that the pool was filled with various wastes including waste oils, solvents, and polychlorinated biphenyls (PCBs). According to the recommendations outlined in the RFA/ESI, geophysical surveys were conducted to locate the boundaries and dimensions of the pool. The geophysical surveys delineated the pool boundary as a 100-foot long by 50-foot wide pool. The RFA/ESI Report recommended upgrading the AOC to a Potential Release Location (PRL). The site was identified as Solid Waste Management Unit (SWMU) 2706.



EXPLANATION

Site L

0 50 100 200 Feet

Site L Location Map
Former March
Air Force Base

Figure 3-9

In May 1994, as part of the RFA investigation, a soil gas survey was conducted at Site L to screen for the presence of volatile organic compounds (VOCs) (Tetra Tech, 1996). Probes were driven into the soil to collect 12 soil gas samples from 12 locations at a depth of 5 feet bgs The samples were collected along a 25-foot grid Chloroform was detected in one sample at a depth of 5 feet bgs at a concentration of 1 67 µg/L. No VOCs were detected above the laboratory reporting limits.

Engineering Evaluation/Cost Analysis (EE/CA) Report. In 1996, Tetra Tech issued *the Engineering Evaluation/Cost Analysis for March Air Force Base, Operable Unit 2, Site L* The objective of the EE/CA was to eliminate potential contaminant sources that pose an imminent threat to groundwater, and to expand upon previous site assessments at Site L to develop appropriate remedial alternatives during the FS phase. In the EE/CA Report prepared for Site L, a streamlined risk evaluation was performed that included the development of a conceptual site model (Tetra Tech, 1996) The conceptual site model was developed by labeling the potential contamination at Site L as primary, secondary, and tertiary sources. The primary sources of contamination included the drums, transformers, or other bulk containers that may have been disposed of into the former swimming pool. These primary sources are treated as the origin of potential contamination at Site L. The secondary source of contamination was identified as soil or debris saturated with or containing high concentrations of contaminants in the immediate areas surrounding the primary source. The tertiary source of contamination refers to soil adjacent to and below the former swimming pool impacted by the secondary contaminant source through vapor or leachate migration Containment structures at Site L were also characterized into two categories (Tetra Tech, 1996) Primary containment structures were the drums and any bulk containers that surround or encase the primary contamination source, and the secondary containment refers to the structure of the pool.

According to the EE/CA report (Tetra Tech, 1996), the geophysical survey performed at Site L did not indicate the presence of any primary contaminants or contamination sources However, the RFA/ESI Report concluded that Site L contains secondary wastes.

The work proposed under the EE/CA was designed to accomplish the following (Tetra Tech, 1996): (1) eliminate the potential source of groundwater contamination; (2) examine whether contaminated soils exist within and under the former pool; (3) determine if these potential sources of contamination are contributing to the known groundwater contamination; and (4) remove and/or reduce the continued and future releases of contaminants to groundwater

Excavation of Pool and Confirmation Sampling. In June 1996, a removal action was conducted at Site L to excavate, characterize, remove, and dispose of wastes that may have been buried in the former NCO Club swimming pool Removal action activities are documented in the *Final Report of Mitigation Action at Site L, March Air Reserve Base, California* (Tetra Tech, 2001) The contents of the pool, primarily construction demolition debris and soil, were removed, characterized, and disposed appropriately. Once the pool structure was removed, confirmation soil samples were collected from the sidewalls and the bottom of the excavation and analyzed for a variety of parameters (i.e., metals, TPH, SVOCs, VOCs, organochlorine pesticides/PCBs). The only analyte detected was PCBs. The PCBs were detected in several samples at concentrations exceeding residential and industrial PRGs

Initial Background Sampling. In July/August 1996, eleven background samples were collected from eight locations surrounding the former NCO Club swimming pool (Tetra Tech, 1999). Samples were collected from the surface and at 1 foot and 2 feet bgs and analyzed for PCBs using EPA Method 8080 Seven of the eleven samples contained PCBs at concentrations ranging from 0.054 mg/kg to 1.79 mg/kg. Concentrations in all but one sample exceeded the 1998 U.S. EPA Region IX residential PRG for PCBs (0.2 mg/kg), and one sample had concentrations in excess of the 1998 industrial PRG of 1.3 mg/kg (Table 3-10). Residential risk from potential exposure to surface soil was calculated at about 9E-6 using the cancer endpoint PRG of 0.2 mg/kg and the highest concentration encountered of 1.79 mg/kg PCBs in BK3-2. Industrial risk was calculated as 1.4E-6 using the same concentration and the industrial PRG of 1.3 mg/kg.

Table 3-10. PCB Concentrations in Background Samples (Summer 1996)

Sample ID	Date Collected	Depth (feet bgs)	PCB Concentrations (mg/kg)			
			Aroclor 1016	Aroclor 1254	Aroclor 1260	Total PCBs
BK1-0.5	7/10/96	0.5	**0.54**	**1.1**	**0.15**	**1.79**
BK-1	7/10/96	1.0	ND	0.14	0.072	**0.21**
BK2-0.5	7/10/96	0.5	ND	**0.61**	**0.28**	**0.89**
BK3-1	8/6/96	1.0	ND	ND	**1.1**	**1.1**
BK3-2	8/6/96	2.0	ND	ND	**1.6**	**1.6**
BK4-2	8/6/96	2.0	ND	ND	**0.86**	**0.86**
BK5-1	8/6/96	1.0	ND	ND	ND	ND
BK6-2	8/6/96	2.0	ND	ND	ND	ND
BK7-1	8/6/96	1.0	ND	ND	**0.31**	**0.31**
BK8-1	8/6/96	1.0	ND	ND	ND	ND
BK8-2	8/6/96	2.0	ND	ND	ND	ND
U.S. EPA Region IX PRGs (residential) mg/kg - 1998			0.2	0.2	0.2	0.2
U.S. EPA Region IX PRGs (industrial) mg/kg - 1998			1.3	1.3	1.3	1.3

Note: Concentrations above the residential PRG are in **BOLD**
bgs = below ground surface
ND = analyte not detected above Reporting Limit
PRG = Preliminary Remediation Goal
mg/kg = milligram per kilogram

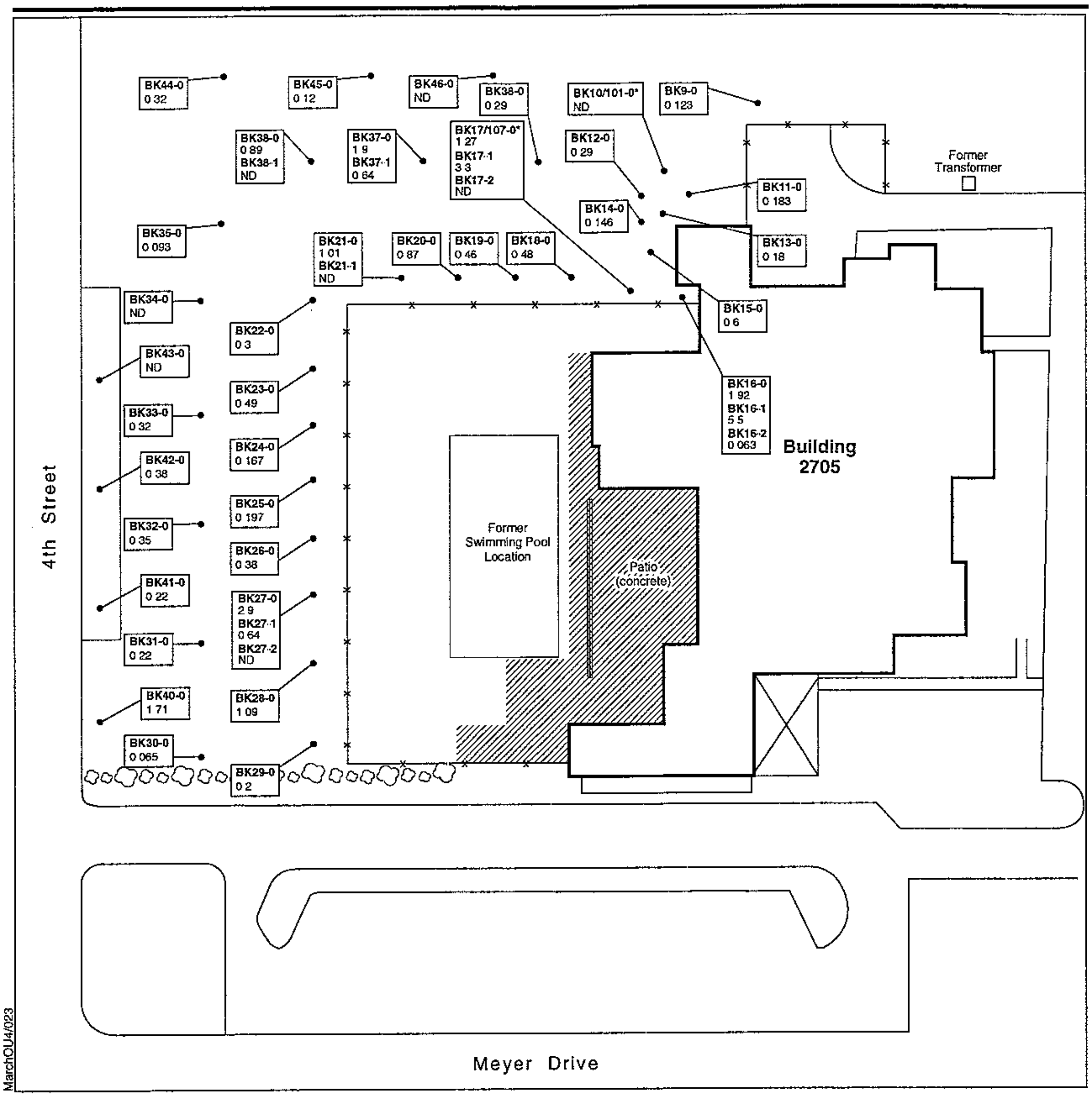
Based on the results of this sampling effort, DTSC requested additional surface soil sampling outside the perimeter fence to determine the extent of contamination California DTSC also recommended sampling near the pad-mounted transformer, a suspected source of PCB contamination at the northeast corner of the site.

For this site, 1998 U S EPA Region IX residential PRGs were used to evaluate potential risk, based on future land use options. Residential standards were used because they provide the greatest protection to potential receptors while allowing for unrestricted land use.

In September 1996 and February 1997, additional excavation of soil and re-sampling was conducted in the area. After three phases of excavation and sampling, final sampling results indicated PCB-contaminated soil ranging from 0.091 mg/kg to 6 4 mg/kg at depths ranging from 14 to at least 20 feet bgs (maximum sampling depth); however, residual PCB contamination was found to be less than U.S. EPA industrial PRGs. In addition, the residual contaminants were detected at depths greater than 10 feet bgs (Tetra Tech, 1999). Three rounds of excavation and follow-up confirmation sampling as part of the removal action indicated polychlorinated biphenyl (PCB)-contaminated soils remained in the deep end of the pool and in surface and near surface soils from areas to the north and west of the excavation. Investigations concluded that a single contaminant source was unlikely and that contamination was probably the result of generalized application of PCB-containing oils for dust or weed control (Tetra Tech, 2001) With the approval of regulators, the excavation was backfilled with 14 feet of imported clean soil. The soil eliminates or greatly reduces the exposure risk to potential receptors. To mitigate the remaining residual contamination, installation of an asphalt cap over Site L was recommended. A Work Plan was developed and approved which outlined capping procedures at Site L *(Work Plan for Mitigation Action at Site L March Air Force Base, California* [U.S. Air Force, 1998b])

Additional Background Sampling. Responding to requirements issued by California DTSC, additional background samples were collected to determine the vertical and lateral extent of PCB contamination outside the pool enclosure (Tetra Tech, 1999). As recommended in the Work Plan and approved by DTSC, a step-out approach was used, beginning with sampling of surface soils close to the fence. Additional samples were to be taken at deeper levels and/or further away from the fence if initial concentrations were found to exceed the U.S. EPA Region IX residential PRG. The sampling rationale and protocol are described in Section 7.0 of the work plan (U.S. Air Force, 1998b).

<u>Initial Sampling (Phase I)</u>. The first set of samples were collected in September 1998 at locations surrounding the former NCO Club swimming pool shown on Figure 4 in *Results of Additional Sampling, Site L - Former NCO Club Swimming Pool, March Air Force Base, California* (Tetra Tech, 1999). Twenty-one surface soil samples (BK-9 through BK-29) and two duplicates (BK-101 and BK-107) were collected Figure 3-10 shows the sampling locations for all samples collected at the site. All samples were analyzed for PCBs by EPA Method 8080, and the sample with the highest concentration of PCBs was also analyzed for dioxins/furans by EPA Method 8290.



EXPLANATION

Fence

Block Wall

Concrete

• Surface Soil Samples (approximate location)

* Duplicate

ND Not Detected

0 32 5 65 Feet

Note: Concentration are in mg/kg. Concentrations are the sum of isonomers

Site L Former NCO Club Swimming Pool Additional Background Sample Locations and PCB Concentrations

Figure 3-10

PCBs (Aroclor 1254 and Aroclor 1260) were found in all but three of the samples collected (Table 3-11). Concentrations ranged from 0.048 mg/kg in BK-9 to 2.9 mg/kg in BK-27 (Tetra Tech, 1999). Fifteen of the samples (including one of the duplicates) had concentrations of either Aroclor 1254 and 1260 or both in excess of the residential PRG of 0.2 mg/kg. In addition, one sample (BK-27 at 2.9 mg/kg) exceeded the 1998 industrial PRG of 1.3 mg/kg. Laboratory reports, QA/QC documents, and COC records, are included in Appendix B of *Results of Additional Sampling, Site L - Former NCO Club Swimming Pool, March Air Force Base, California* (Tetra Tech, 1999)

Table 3-11. PCB Concentrations - Phase I Sampling (September 1998)

	PCB Concentrations (mg/kg)		
Sample No.	Aroclor 1254	Aroclor 1260	Total PCBs
BK-9	0.048	0.075	0.123
BK-10	<0.03	<0.03	ND
BK-101*	<0.031	<0.031	ND
BK-11	0.073	0.11	0.183
BK-12	<0.03	<0.03	ND
BK-13	0.067	0.11	0.177
BK-14	0.062	0.084	0.146
BK-15	**0.31**	**0.29**	**0.60**
BK-16	**0.62**	**1.3**	**1.92**
BK-17	**0.43**	**0.93**	**1.36**
BK-107*	**0.39**	**0.88**	**1.27**
BK-18	**0.26**	**0.22**	**0.48**
BK-19	0.19	**0.27**	**0.46**
BK-20	**0.34**	**0.53**	**0.87**
BK-21	**0.39**	**0.62**	**1.01**
BK-22	0.11	0.19	**0.30**
BK-23	0.14	**0.35**	**0.49**
BK-24	0.084	0.083	0.167
BK-25	0.086	0.11	0.197
BK-26	**0.38**	<0.03	**0.38**
BK-27	**2.9**	<0.03	**2.9**
BK-28	**0.57**	**0.52**	**1.09**
BK-29	**0.20**	<0.03	0.20
U.S. EPA Region IX PRGs (residential) mg/kg – 1998/2002	0.20**/0.22	0.20**/0.22	0.20**/0.22
U.S. EPA Region IX PRGs (industrial) mg/kg – 1998/2002	1.3**/0.74	1.3**/0.74	1.3**/0.74

Note: Concentrations exceeding residential PRGs are **BOLD**
* = Duplicate sample
** = Cancer endpoint for PCBs
mg/kg = milligram per kilogram
PRG = Preliminary Remediation Goal

Residential health risks were calculated as 9.6E-6, using the 1998 U.S. EPA risk screening approach, a maximum concentration of 1.92 mg/kg and the residential PRG of 0.2 mg/kg. Using the same approach, the industrial risk was calculated as 1.5E-6, using the same concentration and the 1998 industrial PRG of 1.3 mg/kg

Analysis of BK-27 by EPA Method 8290 found 12 dioxin/furan isomers at concentrations ranging from 0 79 nanogram per kilogram (ng/kg) 1,2,3,4,7,8-HxCDD to 670 ng/kg 1,2,3,4,6,7,8, 9-octachlorodibenzo-p-dioxin (Table 3-12). Concentrations were evaluated for human health risk by applying the international toxicity equivalency factor (I-TEF) method Using this method, concentrations of different isomers were converted to equivalent concentrations of the most toxic isomer 2,3,7,8-tetradichlorobenzo-p-dioxin (2,3,7,8-TCDD). The normalized value was then compared to the PRGs for 2,3,7,8-TCDD. These calculations show that the total TEF concentration (13 ng/kg) is above the residential PRG of 3.8 ng/kg but slightly below the industrial PRG of 30 ng/kg. Using the risk screening process, residential risk was calculated as 3.4E-6 and the industrial risk as 4.3E-7.

Table 3-12. Dioxin/Furan Results - Background Sample BK-27-0 (Phase I Sampling)

Isomer	Concentration (ng/kg)	TEF	TEF Concentration (ng/kg)
1,2,3,4,7,8-HxCDF	50	0.1	5.0
1,2,3,6,7,8-HxCDF	29	0.1	2.9
2,3,4,6,7,8-HxCDF	17	0.1	1.7
1,2,3,7,8,9-HxCDF	11	0.1	1.1
1,2,3,4,7,8-HxCDD	0.79	0.1	0.079
1,2,3,6,7,8-HxCDD	2.9	0.1	0.29
1,2,3,7,8,9-HxCDD	1.5	0.1	0.15
1,2,3,4,6,7,8-HpCDF	45	0.01	0.45
1,2,3,4,7,8,9-HpCDF	18	0.01	0.18
1,2,3,4,6,7,8-HpCDD	74	0.01	0.74
OCDF	87	0.001	0.087
OCDD	670	0.001*	0.67
Total TEF Concentration:			13.35 ng/kg or 0.0000133 mg/kg; 1.3×10^{-5} mg/kg
U.S EPA Region IX PRG (residential) mg/kg - 1998			0.0000038 mg/kg; 3.8×10^{-6} mg/kg
U.S EPA Region IX PRG (industrial) mg/kg - 1998			0.000038 mg/kg; 3.8×10^{-5} mg/kg

ng/kg = nanogram per kilogram
mg/kg = milligram per kilogram
OCDD = octachlorodibenzo-p-dioxin
OCDF = octachlorodibenzofuran
PRG = Preliminary Remediation Goal
* = Value is for 2,3,7,8-TCDD
TEF = Toxicity Equivalency Factor

Additional Sampling. Several samples collected during the initial (Phase I) background sampling event had PCB concentrations in excess of residential PRGs, requiring additional sampling per work plan requirements. Additional samples were collected in a step outward approach from the initial sampling points (i.e., another 50 feet out and the new sampling locations were spaced

50 feet apart from each other). In addition, samples were collected at a depth of 1 foot at three locations (BK-16, BK-17, and BK-27) where surface sample concentrations exceeded industrial PRGs.

November 1998 Sampling Nine surface soil samples (BK-30 through BK-38) and one duplicate sample (BK-39) were collected PCBs (Aroclor 1254 and Aroclor 1260) were found in all but one (BK-34) of the surface soil samples. Detected PCB concentrations ranged from 0.065 mg/kg in BK-30 to 5.8 mg/kg in BK-39, the duplicate sample of BK-36 (Table 3-13) Only three of the samples (BK-30, BK-34, and BK-35) had concentrations below the residential PRG, and two had total concentrations exceeding the industrial PRG (BK-37 at 1 9 mg/kg and BK-39 at 5 8 mg/kg).

Table 3-13. PCB Concentrations - November 1998 Sampling

Sample No.	PCB Concentrations (mg/kg)		
	Aroclor 1254	Aroclor 1260	Total PCBs
BK-16-1	**1.8**	**3.7**	**5.5**
BK-17-1	**1.1**	**2.2**	**3.3**
BK-27-1	**0.64**	ND	**0.64**
BK-30-0	ND	0.065	0.065
BK-31-0	0.11	0.11	**0.22**
BK-32-0	0.16	0.19	**0.35**
BK-33-0	0.15	0.17	**0.32**
BK-34-0	ND	ND	ND
BK-35-0	0.039	0.054	0.093
BK-36-0	**0.43**	**0.46**	**0.89**
BK-39-0*	**2.5**	**3.3**	**5.8**
BK-37-0	**0.80**	**1.1**	**1.9**
BK-38-0	0.12	0.17	**0.29**
U.S. EPA Region IX PRGs Residential (mg/kg) – 1998/2002 PRG	0.20**/.22	0.20**/.22	0.20**/.22
U S. EPA Region IX PRGs Industrial (mg/kg) – 1998/2002 PRG	1.3**/0.74	1.3**/0.74	1.3**/0.74

Note: Concentrations Residential PRGs are **BOLD**.
* = Duplicate of BK-36-0
** = Cancer endpoint for PCBs
mg/kg = milligram per kilogram
PCB = polychlorinated biphenyl
PRG = Preliminary Remediation Goal

Concentrations also exceeded residential PRGs in the three samples collected at 1-foot bgs (BK-16, BK-17, and BK-27). Concentrations ranged from 0 64 mg/kg in BK-27-1 to 5.5 mg/kg in BK-16-1. At concentrations of 5.5 mg/kg and 3.3 mg/kg, respectively, both BK-16-1 and BK-17-1 also exceeded the industrial PRG of 1.3 mg/kg.

Residential health risks were calculated as 2.9E-5, using the U.S. EPA risk screening approach of a maximum concentration of 5.8 mg/kg and the 1998 residential PRG of 0.2 mg/kg. Using the same approach, the industrial risk was calculated as 4.5E-6 using the same concentration and the 1998 industrial PRG of 1.3 mg/kg.

Testing was performed on the sample with the highest concentration of PCBs (sample BK-39) (Table 3-14) for dioxins and furans. According to the I-TEF and U.S. EPA PRG, the residential risk from dioxins and furans in this sample is 2.4E-6. Industrial risk was calculated to be less than 1.0E-6. These are at least an order of magnitude less than the risk from exposures to the PCBs

Table 3-14. Dioxin/Furan Results - Background Sample BK-39 (November 1998 Sampling Event)

Isomer	Concentration (ng/kg)	TEF	TEF Concentration (ng/kg)
2,3,7,8-TCDF	4.4	1	4.4
1,2,3,7,8-PeCDF	1.7	0.05	0.085
2,3,4,7,8-PeCDF	4.8	0.5	2.4
1,2,3,4,7,8-HxCDF	8.0	0.1	0.8
1,2,3,6,7,8-HxCDF	3.6	0.1	0.36
2,3,4,6,7,8-HxCDF	3.3	0.1	0.33
1,2,3,6,7,8-HxCDD	1.7	0.1	0.17
1,2,3,4,6,7,8-HpCDF	15.0	0.01	0.15
1,2,3,4,7,8,9-HpCDF	2.5	0.01	0.025
1,2,3,4,6,7,8-HpCDD	25.0	0.01	0.25
OCDF	21.0	0.001	0.021
OCDD	230.0	0.001	0.23
	Total TEF Concentration		9.2 ng/kg 9.2×10^{-6} mg/kg
U.S. EPA Region IX PRG Residential (mg/kg) - 1998*			0.0000038 mg/kg 3.8×10^{-6} mg/kg
U.S. EPA Region IX PRG Industrial (mg/kg) - 1998*			0.00003 mg/kg 3×10^{-5} mg/kg

ng/kg = nanogram per kilogram
mg/kg = milligram per kilogram
PRG = Preliminary Remediation Goal
* = Value is for 2,3,7,8-TCDD
TEF = Toxicity Equivalency Factor

February 1999 Sampling. In February 1999, seven surface soil samples (BK-40 through BK-46) were collected. Samples were also collected at BK-16, BK-17, BK-21, BK-27, BK-36, and BK-37 at a depth of 1 foot bgs and at BK-16 and BK-27 at 2 feet bgs. One duplicate sample was collected at BK-36. The results of this sampling event are shown in Table 3-15. Samples were taken at additional locations to the west and north of previous sampling sites and at deeper depths at several locations where PCBs were detected at concentrations that exceeded industrial risk levels. In general the results of this most recent

Table 3-15. PCB Concentrations (February 1999 Sampling)

Sample No.	PCB Concentrations (mg/kg)		
	Aroclor 1254	Aroclor 1260	Total PCBs
BK-16-2	<0.035	0.063	0.063
BK-17-2	<0.034	<0.034	ND
BK-21-1	<0.034	<0.034	ND
BK-27-2	<0.035	<0.035	ND
BK-36-1 (BK-47-1 Duplicate)	<0.037 <0.037	<0.037 <0.037	ND
BK-37-1	0.28	0.36	**0.64**
BK-40-0	0.77	0.94	**1.71**
BK-41-0	0.11	0.11	**0.22**
BK-42-0	0.19	0.19	**0.38**
BK-43-0	<0.037	<0.037	ND
BK-44-0	0.16	0.16	**0.32**
BK-45-0	0.045	0.055	0.1
BK-46-0	<0.038	<0.038	ND
U.S. EPA Region IX PRGs Residential (mg/kg) – 1998/2002 PRGs	0.20/0.22	0.20/0.22	0.20/0.22
U.S. EPA Region IX PRGs Industrial (mg/kg) – 1998/2002 PRGs	1.3/0.74	1.3/0.74	1.3/0.74

sampling show decreasing concentrations to the north at the surface and at locations resampled at a deeper depth. To the west, no distinct trend is evident. The highest concentration from this sampling phase was detected in the sample located in the southwestern-most region (BK-40-0) at 1.71 mg/kg. Sample BK-40-0 was also the only sample to exceed the 1998 industrial PRG. Concentrations of PCBs in four additional samples exceed the 1998 residential PRG: BK-37-1, BK-41-0, BK-42-0, and BK-44-0. BK-41-0 and BK-42-0 are west of the site and BK-44-0 is northwest of the site. BK-37-1 was collected from 1-foot bgs at the BK-37-0 location north of the site.

The residential risk from surface samples based on the 1998 residential PRG of 0.2 mg/kg is 2.7E-6 according to the average value and 3.6E-6 according to the 90UCL (based on analytical results from all samples taken outside the previously fenced area at Site L). The residential risk from subsurface soils based on the results of samples collected from 1 and 2 feet bgs is 5.7E-6 (according to the average value and 1.1E-5 according to the 90UCL). Based on the results of samples collected from all depths, the residential risk is 2.2E-6 according to the average value and 2.9E-6 according to the 90UCL. Industrial risk exceeded 1E-6 only for the 90UCL for subsurface samples only (at 1.7E-6). All risk calculations were based on U.S. EPA Region IX 1998 PRGs.

<u>Summary of Sampling (September 1998-February 1999)</u>. Surface and near-surface soil sampling was conducted during several events during this time period. As a result of the sampling, the presence of PCBs was confirmed in the areas north and west of the pool enclosure. A total of 28 of the 47 samples

residential PRG. Additionally, concentrations in eight samples exceeded the 1998 industrial PRG A pattern of contamination could not be observed using the data collected Both the lateral and vertical extent of the contamination could not be configured. However, in general, PCB concentrations decrease with increasing distance from the pool fence and with increasing depth.

As a result of the sampling events conducted from September 1998 through February 1999, it appears that the distribution of PCB contamination excludes a single contaminant source (Tetra Tech, 1999) Of the four samples collected near the transformer, only two of the samples contained PCBs above detection limits PCB concentrations in these two samples were below the 1998 residential PRG. Therefore, according to Tetra Tech (1999), this information seems to exclude the transformer as a major contributor to PCB contamination at Site L, and it is more probable that residual PCBs have accumulated from applications of PCB-containing oils for dust or weed control, a common practice in the past.

Tetra Tech recommended in *Results of Additional Soil Sampling, Site L - Former NCO Club Swimming Pool, March Air Force Base, California* (1999), that the site be capped (e.g., asphalt concrete paving a minimum of 4 inches in thickness over the pool area and from the fence to 4th Street to the west and at least 120 feet north of the fence over the existing dirt access road) to limit exposure to surface and subsurface soils Tetra Tech also recommended that land use be restricted to industrial/commercial use to be specified in deed restrictions upon transfer of the land to private holdings.

Mitigation of Site L (Installation of Asphalt Cap). The approved mitigation measures for Site L included the following: (1) placement of 6 inches of clean fill over the contaminated soil (mitigates the remaining residual contamination); (2) capping of the 1.5-acre site with asphalt concrete; and (3) implementation of deed restrictions (i.e., land use restrictions).

In April 2000, Tetra Tech began fieldwork to complete the approved mitigation measures. Field procedures and site photographs documenting this mitigation action are included in *Final Report of Mitigation at Site L, March Air Reserve Base, California* (Tetra Tech, 2001). All fieldwork in support of the mitigation action was completed in June 2000.

3.5.1.2 Previous Recommendations.

The operating and monitoring activities recommended for Site L from previous investigations (Tetra Tech, 2001) include the following:

- Semi-annual inspection and observation of the asphalt cap for overall condition and specifically for any cracks in the asphalt surface Cracks greater than 0 5 inch in depth are repaired, as well as any other damage (e.g., holes or ruts) observed, to ensure the integrity of the cap

- A semi-annual report is prepared that summarizes the inspections, presents photographs of damaged areas, and documents repairs made.

3.5.2 OU4 RI Investigation

The OU4 investigation reviewed existing data related to Site L and summarized that information into this RI Report. The objective is to codify the removal actions in the OU4 ROD.

3.5.2.1 OU4 Objectives.

The objective was to summarize the findings from Earth Tech and Tetra Tech investigations and formalize the recommendations in this RI Report

3.5.2.2 Review of Field Activities.

There were no field activities at Site L during the OU4 RI.

3.5.2.3 Variations from the Work Plan.

This site was not included in the work plan The work conducted during this investigation included a literature review and analysis of the existing information.

3.5.2.4 Summary of Laboratory Methods.

There were no samples collected under the OU4 RI.

3.5.3 Physical Site Conditions

Site L is located in the northwest corner of the former base, east of Riverside Drive and north of Meyer Drive. The site is located in the SW1/4 of the SE1/4, Section 13, Township 3 North (T3N), Range 4 West (R4N) of the San Bernardino Base Meridian in the Sunnymeade 7-1/2 minute quadrangle (USGS, 1967d).

3.5.3.1 Surface Features.

Site L is approximately 1,530 feet above MSL in an area characterized by relatively flat topography. No major drainages are associated with the site

3.5.3.2 Stratigraphy.

Stratigraphy in the region in the general area of Site L is recorded in a boring log for monitoring well 4MW9 (located approximately 550 feet northeast of Site L), dated May 1989. Subsurface soils encountered in 4MW9 consisted primarily of light tan to reddish-brown, medium- to coarse-grained sands with scattered silts and clays. Total depth of the boring was 81.5 feet bgs. Bedrock was not encountered in the boring.

3.5.3.3 Groundwater

The EE/CA for OU2, Site L (Tetra Tech, 1996), states that groundwater at Site L was encountered at approximately 50 feet below the TOC of monitoring well (MW) 4MW9. This well is approximately 550 feet northeast of Site L. The inferred groundwater flow direction is to the southwest. While groundwater was not part of this investigation, water levels collected in February 2004 at 28MW8 (monitoring well approximately 1,800 feet southwest of Site L) indicate groundwater levels at 26 feet bgs. The groundwater flow direction is to the southeast.

3.5.4 Nature and Extent of Contamination

Remaining site contamination is limited to PCB contamination is soils located beneath the asphalt cap. Residual contamination is documented in the Final Report of Mitigation Action at Site L prepared by Tetra Tech (2001).

3.5.4.1 Soil Contamination

Final confirmation samples indicate PCB-contaminated soil ranges from 0.091 mg/kg to 6.4 mg/kg at depths of 14 to at least 20 feet bgs (maximum sampling depth). Residual contaminants at depths greater than 10 feet bgs remain at the site (Tetra Tech, 1999). In addition, surface and near surface soil samples collected from around the former swimming pool area show PCBs are present in the soil at concentrations ranging from non-detect (<0.03 mg/kg) to 5.8 mg/kg

3.5.4.2 Groundwater Contamination

To ensure that groundwater would not be adversely affected, a migration analysis was performed at the request of the California Regional Water Quality Control Board (CRWQCB). The results of the analysis concluded that the probability of significant groundwater impact is minimal (Tetra Tech, 2001). Therefore, groundwater sampling has not been conducted at Site L

3.5.4.3 Site Characterization Summary

The source of PCB contamination at Site L has not been identified. Previous investigations concluded that a single contaminant source was unlikely and that contamination was probably the result of generalized application of PCB-containing oils for dust or weed control (Tetra Tech, 2001).

Buried wastes are excluded as significant contributors due to the following: (1) the concrete sidewalls, bottom slabs, and other pool structures were found to be in good condition without any evidence of staining; and (2) PCBs have been detected in background samples collected in the pool vicinity.

The residual contamination at Site L is not considered a threat to human health, the environment, or groundwater resources, because contamination is limited to subsurface soils at depths greater than 14 feet, and the site is capped with asphalt. Therefore, there is no concern associated with direct exposure to human and ecological receptors.

3.5.5 Potential Migration Pathways

Residual PCB contamination of soils at depths of 20 feet bgs at the south end of the pool has a limited probability for transport due to the following reasons:

- Contamination is limited to subsurface soils at depths greater than 20 feet and is therefore not a concern with respect to direct exposure to human and ecological receptors

- A migration analysis was performed at the request of the RWQCB. The analysis found the likelihood of significant groundwater impact to be minimal.

For these reasons, remaining site contamination does not threaten natural resources, and transport mechanisms are not of concern at the site.

3.5.6 Risk Assessment

No formal risk assessment was conducted for this site during the OU4 RI. The risk presented in the following text is a summary of the site assessment conducted by Tetra Tech, Inc, in 2000 PCB-impacted soil remains at the site at depths greater than 14 feet bgs and is mitigated with the emplacement of the asphalt cap that acts as a barrier to any contact with PCBs. Based on analytical data from all samples taken outside the pool area, the residential risk from surface soil samples is 2.7×10^{-6} based on the average concentration and is 3.6×10^{-6} based on the 90UCL (Tetra Tech, 2001). The residential risk from subsurface soil based on the results of samples collected from 1 to 2 feet bgs is 5.7×10^{-6} based on the average concentration and 1.1×10^{-5} based on the 90UCL. Using analytical results from all depths, residual risk is 2.2×10^{-6} based on average concentrations and 2.9×10^{-6} based on the 90UCL. Risk based on industrial reuse does not exceed 1×10^{-6} using the average concentrations.

3.5.7 Conclusions

Three rounds of excavating and confirmation sampling within the pool indicated PCB-impacted soils remained in the deep end of the pool. PCB contamination was also detected in surface and near-surface soils from areas to the north and west of the excavation Investigations at Site L concluded that a single contaminant source was unlikely and that contamination was probably the result of generalized application of PCB-containing oils for dust or weed control. With the approval of regulators, the excavation was backfilled with imported soil. To mitigate the remaining residual contamination, an asphalt cap was installed over the site (Tetra Tech, 2001) and lease restrictions prohibit reuse of the site for residential purposes.

The Air Force and regulators concluded that the 14 feet of clean backfill emplaced over the contaminated soil disrupts the exposure pathway eliminating or greatly reducing risk to potential receptors. A migration analysis (requested by the RWQCB) found the likelihood of significant groundwater impact to be minimal.

Final sampling results indicated PCB-contaminated soil ranges from 0.091 mg/kg to 6.4 mg/kg at depths of 14 to at least 20 feet bgs. In addition, the residual contamination was found in surface soil at levels ranging from non-detect (0.03 mg/kg) to 5.8 mg/kg. Risk associated with the site is within the 10^{-5} to 10^{-6} range and can be managed by implementing deed restrictions to prohibit residential reuse when the property is transferred.

3.5.8 Recommendations

Upon transfer to the public, restrictions will be placed on the property to prohibit development for residential purposes.

There are no other recommendations for Site L based on previous investigations conducted at the site. The Air Force has determined that the current maintenance and inspection requirements for the asphalt cap are not required

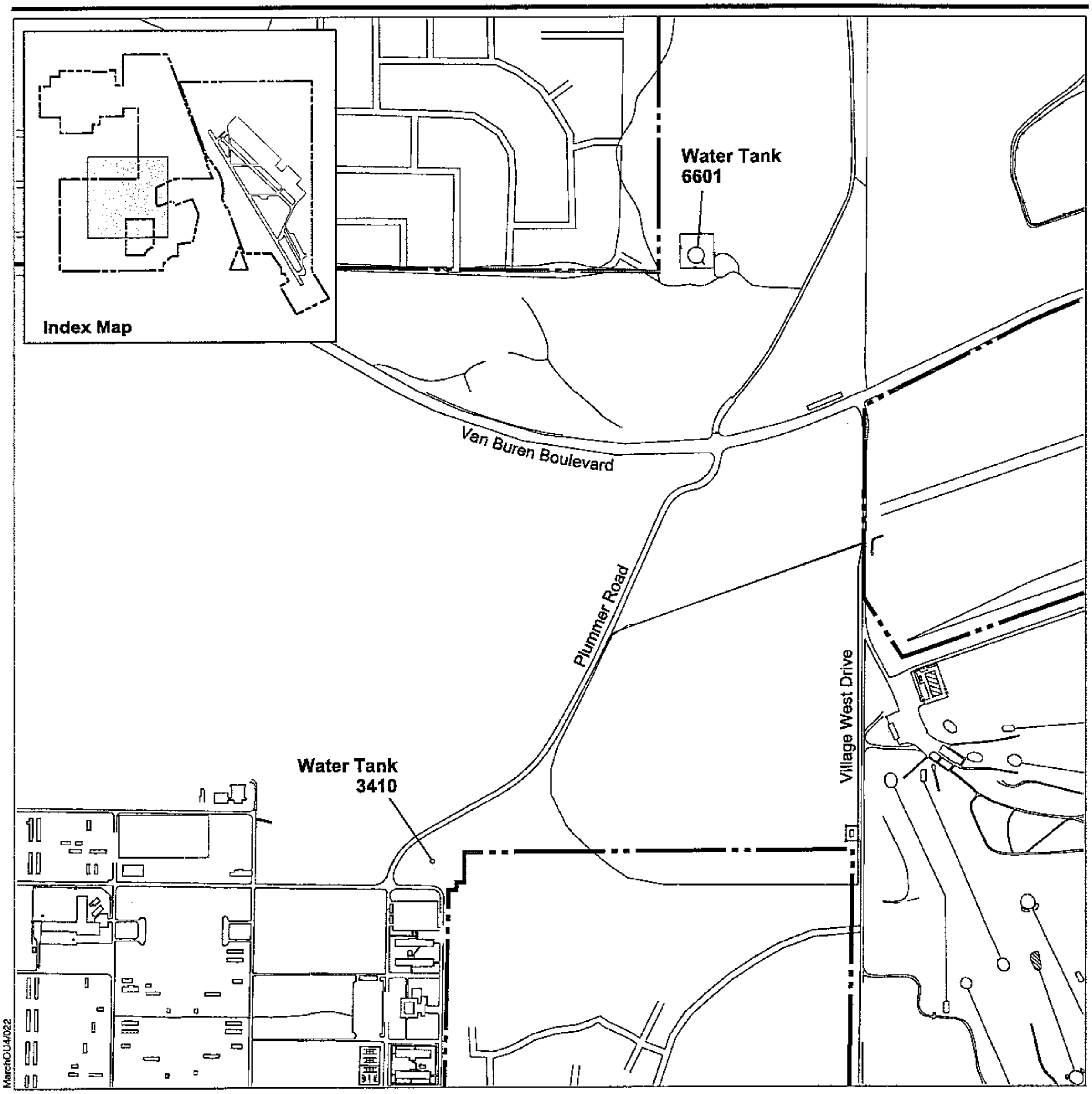
3.6 WATER TOWER 3410

3.6.1 Site Background

Water Tower 3410 is an aboveground water storage tank located on West March at the intersection of Plummer Road and 11th Street (Figure 3-11), south of the Site 6 landfill. Due to the presence of mercury pot water flow controllers at other March water storage facilities (it was speculated that past spills from the mercury pot caused contamination of soils beneath and surrounding the valve controller), and its similarity to Water Tower 407 (which used a valve controller with a 6-inch mercury pot for flow control), it was suspected that Water Tower 3410 may also have mercury-contaminated soils.

3.6.1.1 Previous Investigations.

A preliminary site visit to Water Tower 3410 was conducted in November 1997 During this visit, attempts to locate a valve vault similar to Water Tower 407 were unsuccessful. March ARB Department of Public Works was contacted to determine if a vault ever existed at the site. Interviews with department personnel indicated the building never contained a vault. The only mercury controls at Water Tower 3410 are those that control associated pumps. Four controls (located above ground) are attached to the water tower rather than in a vault, and contain only small amounts of mercury. The objective of the OU4 RI was to determine if mercury contamination was present at the site.



EXPLANATION

0 215 430 860 Feet

Water Tank 3410 and 6601 Site Location March AFB

Figure 3-11

3.6.1.2 *Previous Recommendations.*

There were no previous investigations conducted at Water Tower 3410. The site was suspected of containing mercury contamination because of its similar construction to Water Tower 407 (IRP Site 44).

3.6.2 OU4 RI Investigation

The OU4 investigation was designed to investigate the potential release of mercury from mercury-containing control valves located on the water tank. While the Basewide RI/FS Work Plan did not specifically include Water Tower 3410, the site was suspected of containing mercury contamination because of its similar design to Water Tower 407 (IRP Site 44). The OU4 investigations followed the same protocol established for IRP Site 44 in the Basewide RI/FS Work Plan (Earth Tech, 1998).

3.6.2.1 *OU4 Objectives.*

Objectives of the OU4 RI were to determine if mercury contamination was present at the site.

3.6.2.2 *Review of Field Activities.*

Soil samples were collected beneath the control boxes at the water tower in three separate locations (Figure 3-12). Sample locations were chosen in areas with the highest potential for contamination and were collected by clearing away surface vegetation followed by hand excavation from the surface to 6 inches below the surface using a stainless steel hand trowel. Soil samples were submitted to the contract laboratory for analysis under EPA Method SW 7471A. Mercury concentrations detected in the samples collected were well below EPA Region IX PRG values. A duplicate soil sample was collected from one location. All samples were analyzed for mercury by EPA Method SW 7471A. Analytical results showed only trace amounts of mercury in site soils

3.6.2.3 *Variations from the Work Plan.*

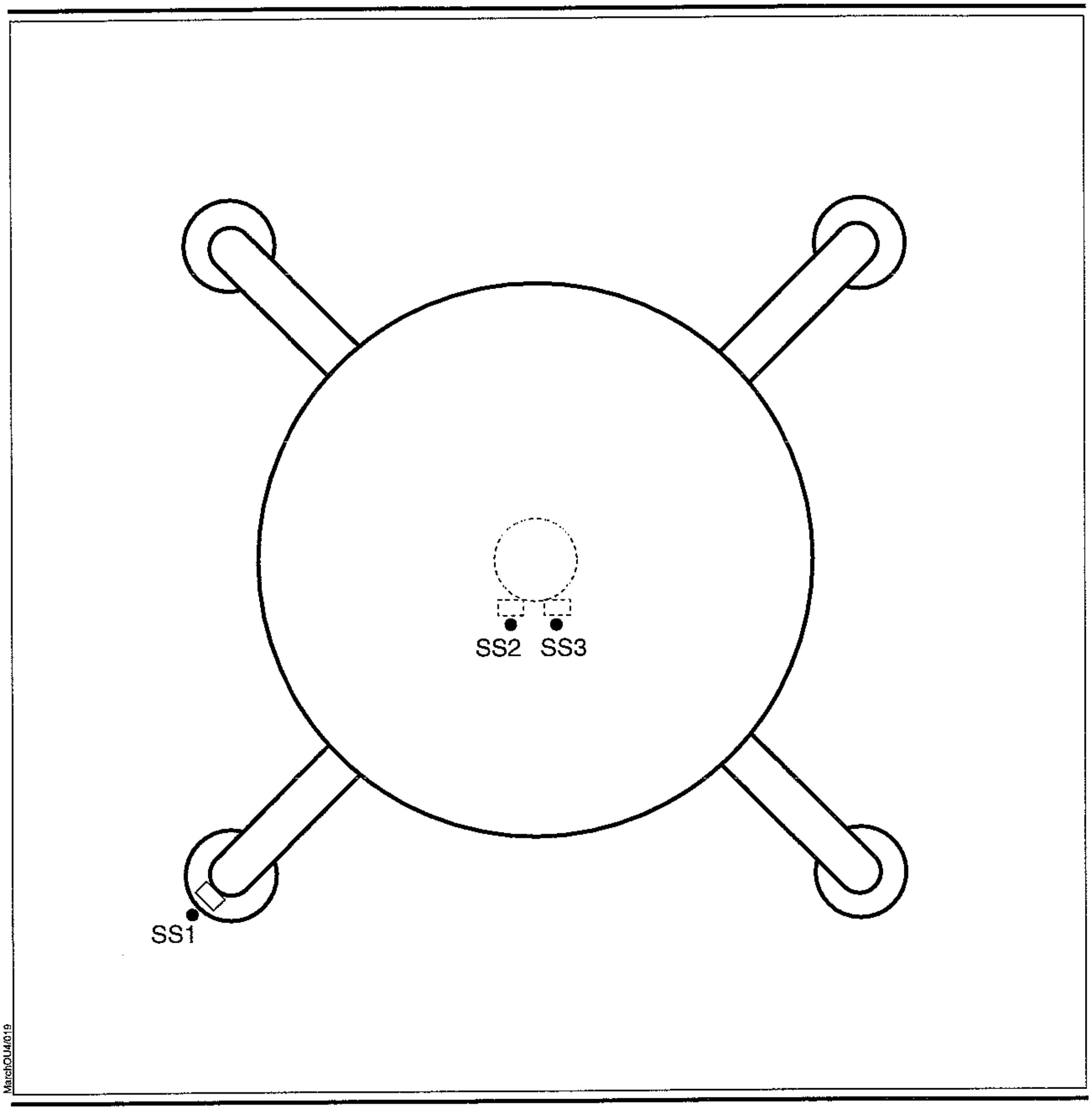
There were no variations from the approved work plan Soil samples were collected, and the samples were analyzed as described in the approved work plan.

3.6.2.4 *Summary of Laboratory Methods.*

Soil samples collected in support of the investigation conducted at Water Tower 3410 were analyzed for mercury using EPA Method 7471A.

3.6.3 Physical Site Conditions

Water Tower 3410 is located on West March at the intersection of Plummer Road and 11th Street. The site is located in the NW1/4 of the SW1/4, Section 27, Township 3 South, Range 4 West, San Bernardino Base Meridian, in the Riverside East 71/2-minute quadrangle (USGS, 1987b).



EXPLANATION

SS1 Sample Location

Valve Box

Not to Scale

Building 3410
Soil Sample Locations

Figure 3-12

3.6.3.1 Surface Features.

Water Tower 3410 is approximately 1,705 feet above MSL. The overall topographic slope is gentle to the east/northeast. There are no surface water bodies at the site.

3.6.3.2 Stratigraphy.

Deep soil borings were not installed at the site However, the stratigraphy in the general area of Water Tower 3410 is best recorded in a boring log for monitoring well 6M6MW3 (located approximately 2,500 feet east of Water Tower 3410). Surface soils encountered in 6M6MW3 are shallow and extend to approximately 2 feet bgs and consist of yellowish-brown, silty sand to clayey sand. A zone of weathered granite extends from 2 feet to 40 feet bgs Competent bedrock was encountered at 40 feet bgs. Total depth of the boring was 41.0 feet bgs

3.6.3.3 Groundwater.

While groundwater was not part of this investigation, water levels collected in February 2004 at 6M6MW3 (monitoring well approximately 2,500 feet northeast of Water Tower 3410) and 5M6MW5 (monitoring well approximately 3,000 feet northeast of Water Tower 3410) indicate groundwater levels at approximately 33 feet and 48 feet bgs, respectively. The groundwater flow direction is to the east.

3.6.4 Nature and Extent of Contamination

The following sections define the nature and extent of the constituents identified during site investigations at Water Tower 3410

3.6.4.1 Soil Contamination.

Soil samples were collected at three locations beneath the control boxes at the water tower and analyzed for mercury. The sample results showed only trace amounts of mercury detected in surface soils. Trace levels of mercury were present in all samples collected beneath the control boxes. Mercury was detected at a maximum concentration of 0.064 mg/kg. Table 3-16 provides a summary of the analytical results and a comparison to EPA Region IX PRGs

Table 3-16. Water Tower 3410 Sump Sampling Results Compared to PRGs (units in mg/kg)

Sample Label	Method	Analyte	Result (mg/kg)	Qualifier	2002 Residential PRG	Comments
MARCH-3410-TSS01-SL01	7471A	Mercury	0.019	(F)	23	
MARCH-3410-TSS02-SL01	7471A	Mercury	0.018	(F)	23	
MARCH-3410-TSS03-SL01	7471A	Mercury	0 064	(F)	23	
MARCH-3410-TSS03-SL201	7471A	Mercury	0 057	(F)	23	(Replicate)

F = The analyte was positively identified but the associated numerical value is below the reporting limit (RL)

3.6.4.2 Groundwater Contamination

Groundwater contamination was not suspected at this site, and no groundwater investigation was conducted for this site.

3.6.4.3 Site Characterization Summary

Water Tower 3410 is an active water tank, and site soils were suspected of possible mercury contamination due to its similarity to Water Tower 407. Based on results of this investigation (analysis of soil samples for mercury contamination), it does not appear that site soils are contaminated with mercury. In addition, a subsurface valve box (as was present at Water Tower 407) was not known to exist at this site and was not located during the course of this investigation.

3.6.5 Potential Migration Pathways

Based on the confirmed absence of contamination in soils at Water Tower 3410, transport mechanisms are not of concern

3.6.6 Risk Assessment

The scope of the human health risk assessment for Water Tower 3410 included a PRE that was conducted to determine if current or future conditions will pose an unacceptable risk to human health. The risk evaluation estimated human health risks from exposure to the COPCs at Water Tower 3410. Analytical results were compared to the 2002 U.S. EPA Region IX residential PRG for mercury and compounds (23 mg/kg).

Soil sample results from Water Tower 3410 indicated only trace amounts of mercury detected in surface soils. All mercury results were well below the residential PRG of 23 mg/kg.

A site-specific PRE was not conducted at Water Tower 3410 because the concentrations of all constituents were below EPA Region IX residential and industrial PRGs.

3.6.7 Conclusions

Analytical results from Water Tower 3410 showed only trace amounts of mercury detected in surface soils. All mercury results were well below the residential PRG of 23 mg/kg; therefore, a site-specific PRE was not conducted. The screening-level PRE results for surface soil under the residential scenario indicated an RME HI of 0.0003, which is well below the level of concern (RME HI of 1). Additionally, the screening-level PRE results for surface soil under the industrial scenario indicated an RME HI of 0.00001, which is well below the level of concern (RME HI of 1). Both the residential and industrial RME HIs are below the level of concern.

3.6.8 Recommendations

NFA is recommended for Water Tower 3410

3.7 WATER TANK 6601

3.7.1 Site Background

Water Tank 6601 is an aboveground storage tank located north of Van Buren Boulevard and west of Plummer Road (Figure 3-11) in the area known as West March This site is an active 200,000-gallon water tank constructed circa 1942, with appurtenances including valves, piping, and electronic controls. The appurtenances are located inside a fenced area with a concrete floor and a metal roof The enclosure was constructed in the mid 1980s, in response to repeated vandalism at the site Mr. Archie Wall (via telephone interview) reported vandalism occurring on at least six occasions. Each incident apparently resulted in releases of elemental mercury at the site A reservoir or "mercury pot" was broken by vandals during each of the incidents. Some of the elemental mercury was recovered each time; however, no formal cleanup actions were performed. A cage was constructed to protect the controls from additional vandalism The mercury control was removed prior to the OU4 RI investigation, although the exact removal date is unknown.

Water Tank 6601 was not specifically outlined in the project work plan, although it falls under the category of "sites that pose risk " The sampling approach for Water Tank 6601 was the same as that used for Water Tower 3410 and IRP Site 44. Soil samples were collected and analyzed by EPA Method SW-7471A for mercury.

This effort was conducted to determine the presence or absence of mercury in site soils, as well as the horizontal and vertical extent if found. Soil contamination below a 20-foot by 12-foot concrete slab located adjacent to the west side of the water tank was suspected The concrete slab is located inside a fenced steel-roofed enclosure, which also houses control devices and piping A large-diameter underground pipe extends from the base of the water tank through the concrete slab A check valve is located in the approximate center of the pipe between the water tank and the exit point through the slab, where the slab is open to the ground. Because the mercury pot bracket was located above the check valve, it appeared likely that any mercury spillage would have occurred in this area.

3.7.1.1 Previous Investigations.

No previous investigations had been conducted at Water Tank 6601 prior to the OU4 investigation. Water Tank 6601 was suspected of containing elevated concentrations of mercury because the site had been repeatedly vandalized and, during these break-ins, the mercury pots had been broken. Therefore, similar conditions to those identified at Site 44 (Water Tank 407) warranted investigation.

3.7.1.2 Previous Recommendations.

There were no previous investigations at Water Tank 6610. However, because the site conditions were similar to Site 44, an investigation was warranted to determine if mercury was present in the surface and subsurface soil at the site.

3.7.2 OU4 RI Investigation

The following sections detail OU4 objectives, review of OU4 field activities, descriptions of variations from the work plan, and a summary of laboratory methods Since Water Tank 6601 was similar in design to IRP Site 44, sampling protocol followed the Basewide RI/FS Work Plan for IRP Site 44 (Earth Tech, 1998).

3.7.2.1 OU4 Objectives.

The objective of the OU4 investigation at Water Tank 6601 was to determine if elemental mercury was present at the site, and if so, what was the lateral and vertical extent of contamination. Because the site had been vandalized numerous times in the past and because the site was similar to Site 44 (Water Tank 407), the presence of elemental mercury in the surrounding soil was highly likely.

3.7.2.2 Review of Field Activities.

Sample collection was concentrated under the slab and along the pipe from the tank. Eleven of the 13 sample collection points were obtained; the remaining two sample points were on the downgradient (north) side of the water tank outside of the caged slab.

Three soil samples were collected at 6-inch intervals from each sample point starting at 0.5 feet bgs and continuing to 2.0 feet bgs. Samples HB01 through HB10 were collected after coring a 4-inch diameter hole through the concrete slab. All samples were collected in 1.5-inch diameter by 6-inch long stainless steel sleeves, using a slide hammer and sample shoe. The sleeves were capped with Teflon® and plastic end-caps and packed in ice. Complete COC documentation was maintained throughout the collection and handling process

3.7.2.3 Variations from the Work Plan.

The work plan did not specifically identify Water Tank 6601 as a site to be investigated. However, because the site was similar to Site 44 (Water Tank 407), site activities followed the sampling protocol established for Site 44. Sample locations were reviewed with the Air Force and the regulatory agencies prior to the field investigation.

3.7.2.4 Summary of Laboratory Methods.

All soil samples were analyzed for mercury using EPA Method 7471A. Method reporting limits for the mercury analysis were the same as for Site 44 (RL of

0.1 mg/kg) A total of 13 locations were sampled, and a total of 13 samples were collected and analyzed.

All analyses were completed per the approved work plan.

3.7.3 Physical Site Conditions

Water Tank 6601 is located in West March, north of the intersection of Van Buren Boulevard and Plummer Road (Figure 3-10) and west of the former Arnold Heights Housing Area. The site is located in the SE ¼ of the SW ¼ of Section 22, T3S, R4W of the San Bernardino Base Meridian, in the Riverside East 7½ minute quadrangle (USGS, 1967b).

3.7.3.1 Surface Features.

The site is within West March at an elevation of approximately 1,660 feet above MSL. The site is characterized by highly dissected upland topography and consists of highly eroded gullies and exposures of weathered bedrock. The primary flow of surface water at and in the vicinity of Water Tank 6601 is to the east. One primary intermittent stream channel drains to the east near the facility.

3.7.3.2 Stratigraphy.

No boreholes were installed at Water Tank 6601 so a detailed analysis of the site geology was not determined. The site geology is assumed to be similar to other West March sites. Surface soil is assumed to be shallow, with the maximum thickness of soil only tens of feet thick. The soil is underlain by weathered granitic bedrock. Based on drilling conducted by Tetra Tech at nearby sites during the OU2 RI, soil consists primarily as sand with some fines (silts and clay) and gravels. Depth to bedrock ranges from a few feet to as much as 20 feet bgs.

3.7.3.3 Groundwater.

Groundwater was not investigated as part of this study. Based on data presented by Tetra Tech in the OU2 RI, just south of the water tank, groundwater is encountered in weathered bedrock at depths ranging from 10 to 40 feet bgs. The data show seasonal fluctuations. Groundwater flow direction is generally to the east. Groundwater is present in weathered bedrock in unconfined conditions

3.7.4 Nature and Extent of Contamination

During this investigation analytical results from soil samples collected at Water Tank 6601 identified significant mercury contamination in site soils. Remediation of surface and subsurface soils was performed during September 2000 by IT Corporation. Contaminated soils were excavated, confirmation sampling was performed in the active excavations to determine the final excavation depth, and clean fill was placed in the excavation to original grade. All soils above the target cleanup concentration of 1 mg/kg within the valve box and 70 mg/kg outside the valve box were removed and properly disposed (IT Corporation, 2001).

Site contaminants have been remediated to acceptable levels; therefore, no transport mechanisms are of concern at the site.

3.7.4.1 Soil Contamination.

Sample analyses indicated substantial mercury contamination in site soils. The Air Force initiated a remedial action for the mercury-contaminated soils based on this preliminary data. The selected remedy was to remove contaminated media and backfill the excavated area.

Cleanup Action. The soils remediation was performed at Water Tank 6601 in September 2000 (IT Corporation, 2001).

Metal Enclosure, Valves, and Flanges. The control cage had been coated with lead-containing paint; therefore, it was sent to a Class III landfill (Waste Management's Moreno Valley Transfer Station, California). The valves and flanges were disposed at the same facility.

Concrete Debris. Concrete debris containing mercury below the detection level of the on-site XRF screening meter was deposited in a 10 cubic yard roll-off bin and transported for disposal/recycling at the Moreno Valley Transfer Station Concrete containing mercury concentrations, which exceeded 20 mg/kg (actual concentration of 107 mg/kg) but met EPA's Toxicity Characteristic Leachate Procedure (TCLP) analysis (method SW 1311 for mercury), was characterized as California hazardous waste. MP Environmental transported it to the Kettleman Hills Class I Landfill in Kettleman City, California. The section of ring wall removed during excavation was classified as EPA-hazardous waste because mercury was visible on the concrete. The ring wall was covered in Visqueen, demolished into smaller pieces, and placed in two Department of Transportation (DOT)-approved 55-gallon drums These drums were properly marked and labeled and transported by Superior Special Services to their facilities in Phoenix, Arizona, for retorting treatment.

Mercury-impacted Soil. Soils containing over 20 mg/kg mercury content (by solid phase analyses) and less than 0.2 mg/L mercury content (by TCLP analyses) are characterized as California-hazardous waste. Approximately 65 tons of soil (contained in lined roll-off bins) was characterized as California hazardous waste, and transported to Kettleman Hills for disposal.

Soils with over 0.2 mg/L mercury (by TCLP analyses) are characterized as RCRA-hazardous waste. A total of eight drums of soil was characterized as such and transported off site in Department of Transportation-approved 55-gallon drums to Superior Special Services in Phoenix, Arizona.

During the OU4 investigation, soil samples were collected from 13 locations beneath and surrounding the control valves and concrete pad. Sample results indicate mercury concentrations at the site vary from a minimum of 0.15 mg/kg to a maximum of 22,500 mg/kg. The 2002 EPA Region IX PRG for mercury in residential soil is 23 mg/kg. With the exception of HB13, all sample points exceeded the residential PRG value in one or more of the sample intervals Figure 3-13 shows the sample locations associated with this effort

Analytical data are included in Appendix A of this report Sample results indicate mercury concentrations under and adjacent to the concrete slab at Water Tank 6601 were above the 2002 EPA Region IX, residential soil PRG of 23 mg/kg, with the exception of sample location HB13. The 0.5 to 1.0-foot sample interval at all other sample locations was above the residential PRG The 1.0 to 1.5-foot interval is above the residential PRG at sample locations HB03, HB05, HB08, HB11, and HB12. The 1.5 to 2.0-foot interval is above the residential PRG at sample locations HB01, HB04, HB05, HB07, HB08, and HB11 This indicates some degree of variability in the samples, probably due to the nature of the compound. Since elemental mercury was distributed as globules in the soil at this site, the analyzed concentrations can vary dependent upon the location of globules within the sample. Further evidence of this can be seen in the sample duplicates as outlined below:

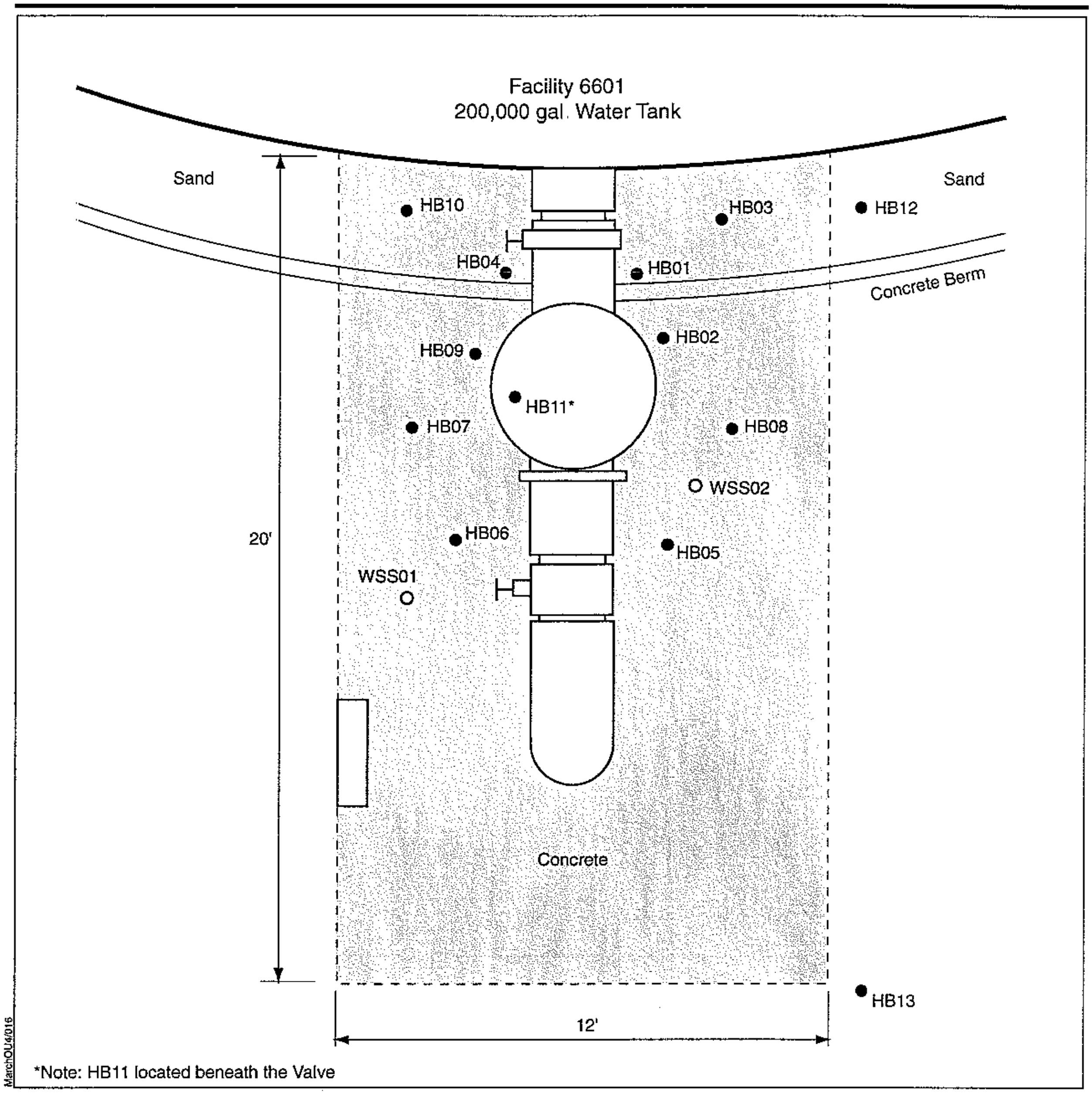
- For Samples HB03SD01 and HB03SD201 (0.5 to 1.0-foot interval) the sample concentration is 924 mg/kg, while the duplicate concentration is 8,910 mg/kg.
- For Samples HB04SD02 and HB04SD202 (1.0 to 1.5-foot interval) the sample concentration is 0.6 mg/kg, while the duplicate concentration is 58.6 mg/kg.
- For Samples HB05SD01 and HB05SD201 (0.5 to 1.0-foot interval) the sample concentration is 22,500 mg/kg, while the duplicate concentration is 1,540 mg/kg.

Remedial Action. Based on the results of the sampling, the Air Force initiated a remedial action to achieve a "clean-closure" prior to transfer of the property The remedial action required removal of the concrete slab and the associated buildings and temporary disconnection of the associated controls. Soils under the slab required removal to a depth greater than 2 feet at several locations (Figure 3-14). The remedial action was performed during September 2000. Screening samples to determine depth of soil removal were collected from each excavation as work progressed (IT Corporation, 2001)

Following appropriate excavation activities, confirmation samples were collected and analyzed by EPA Method SW846-7471A for total mercury, using a MDL of 0.0072 mg/kg and an RL of 0.2 mg/kg. All samples were collected on 21 September 2000 Results of the confirmation sampling are presented in Table 3-17 (IT Corporation, 2001). Confirmation sample locations are shown in Figure 3-15.

3.7.4.2 Groundwater Contamination.

Groundwater contamination was not an issue at Water Tank 6601; therefore, groundwater characterization was not performed during this investigation.

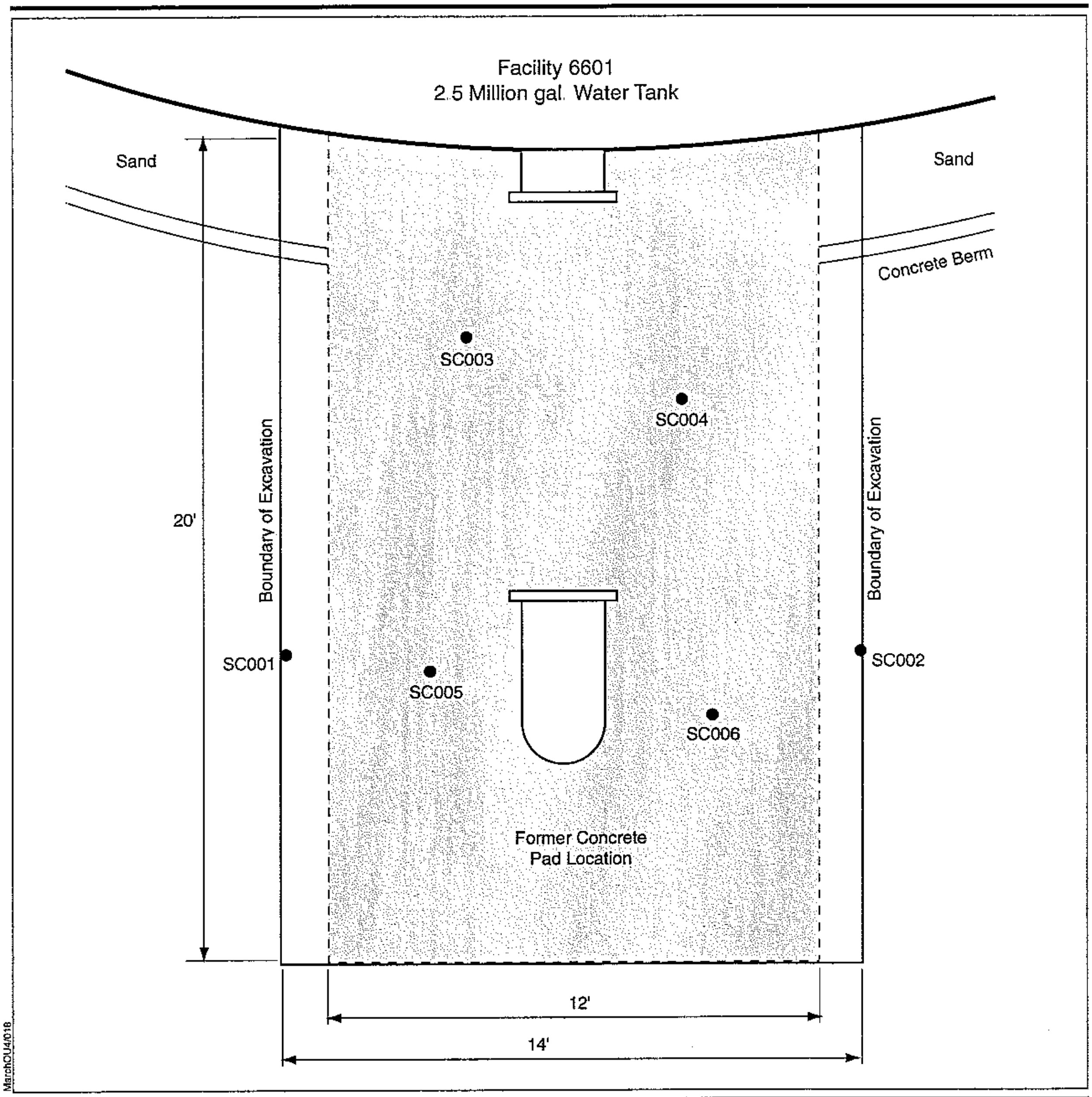


EXPLANATION

Not to Scale

Water Tank 6601 Mercury Sample Locations

Figure 3-13



EXPLANATION

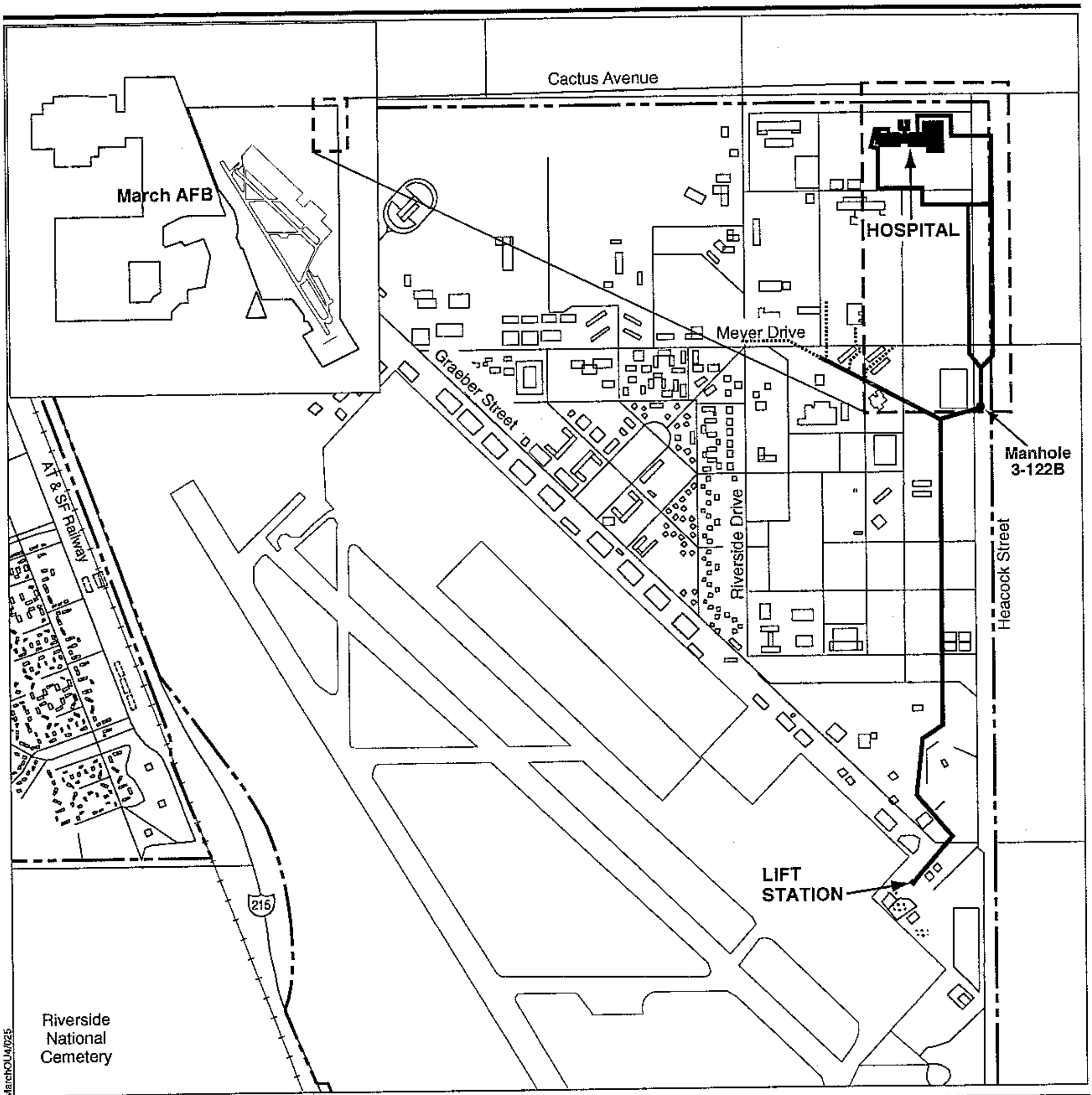
Area of Excavation/Removal Action

● Confirmation Sampling Locations

Not to Scale

Water Tank 6601 Confirmation Soil Sample Locations (IT Corp)

Figure 3-14



EXPLANATION

- March AFB Boundary
- AT&SF Railroad
- Sewer Line
- Extension of Sewer Line

0 400 800 1600 Feet

Site Location
Former Hospital/
Dental Clinic
March AFB

Figure 3-15

Table 3-17. Water Tank 6601 Confirmation Samples

Field Sample ID	Mercury (mg/kg)	Qualifier
MAFBMS-SC001-092100	0.11	(J)
MAFBMS-SC002-092100	0.3	
MAFBMS-SC003-092100	2.7	
MAFBMS-SC004-092100	0.52	
MAFBMS-SC005-092100	0.52	
MAFBMS-SC006-092100	0.29	

(J) The analyte was positively identified the quantity is estimated

3.7.4.3 Site Characterization Summary.

Elevated levels of elemental mercury were found at the site during the OU4 investigation. As a result, the Air Force initiated a removal action similar to that done at Site 44 IT Corporation conducted the removal action in September 2000 and collected confirmation samples from the bottom of the excavation. Results of the confirmation sampling showed that trace levels of mercury contamination remain at the site. Of the six confirmation samples collected, the maximum level of mercury in the bottom of the excavation was 2.7 mg/kg.

3.7.5 Potential Migration Pathways

Residual mercury contamination exists in very low concentrations. Mercury has a limited probability for transport due to its limited mobility in soil For these reasons, remaining site contamination does not threaten natural resources, and transport mechanisms are not of concern at the site

3.7.6 Risk Assessment

Soil excavation and off-site disposal of mercury-contaminated soil was conducted by IT Corporation to remove elevated mercury concentrations. Analytical results from confirmation samples taken after excavation indicate that the elevated mercury concentrations have been removed. Confirmation sample results detected only trace amounts of mercury in site soils The RME HI (0.12) is below the level of concern of 1. The HI (0 004) is also below the level of concern of 1. A site-specific PRE was not conducted because concentrations of mercury are below the residential PRG. A site-specific evaluation was not conducted at Water Tank 6601 because the final mercury concentrations after excavation were below EPA Region IX residential and industrial PRGs.

3.7.7 Conclusions

Soil excavation and off-site disposal were conducted to remove elevated concentrations of mercury Analytical results of confirmation samples taken after excavation indicate that the elevated mercury concentrations have been removed. The sample results showed only trace amounts of mercury detected in site soils. Because the residential RME HI is below the level of concern of 1, NFA is recommended for Water Tank 6601.

3.7.8 Recommendations

The Water Tank 6601 site was suspected of mercury contamination of soils similar to that found at Site 44. Soil samples were collected at locations beneath the control boxes at the water tank and analyzed for mercury. Elevated concentrations of mercury in soils initiated soil excavation and off-site disposal.

Analytical results from confirmation samples collected after the removal action indicate that the elevated mercury concentrations have been removed. Confirmation sample results showed only trace amounts of mercury detected in site soils. Because the residential RME HI is below the level of concern of 1, NFA is recommended for Water Tank 6601.

3.8 BASE HOSPITAL/DENTAL CLINIC

3.8.1 Site Background

The former March Hospital and Dental Clinic are located in the northeast corner of the former base, near the intersection of Cactus and Heacock streets. The main Hospital (Building 2990) is five stories and the Dental Clinic (Building 2995), is one story. A sewer main extends from the hospital/dental clinic, south along the eastern base boundary to the last manhole before the connection of the hospital lines with the "old trunk line" from western portions of the former main base (Manhole 3-122B). Figure 3-15 shows the Hospital and Dental Clinic and the sewer lines that were part of the hospital complex.

Construction of the Hospital was completed in 1966 and modified in subsequent years. The latest addition was completed in 1974. The original construction of the Dental Clinic was completed in 1985. The sewer line, which originates at the complex and includes both of these buildings, was first brought on line with completion of the original hospital building. There are two primary lines collecting effluent flow from the complex. The lines ultimately empty into the old sewer main that flows directly south to the current lifting station, from which sewage is transferred around the south end of the active runway to the current wastewater treatment plant.

3.8.1.1 Previous Investigations.

As part of a mercury characterization study for the former March Environmental Compliance Group (CEV) at the former March AFB, an investigation was performed in 1992 to assess mercury contamination within the sewer lines of the Hospital and Dental Clinic (The Earth Technology Corporation, 1992c). The investigation included the waste collection lines of each building's interior, and the exterior underground sewer lines. A total of 146 samples were collected: 57 samples from the internal waste collection lines, 73 real-time air monitoring samples from sewer ventilation exhaust pipe outlets, 10 samples from the "floor drain" clean outs of the internal lines, and 6 samples from the exterior sewer lines.

Approximately 86 percent of the interior waste collection line samples contained concentrations of mercury above the analytical detection limit. More than one-third of these samples had concentrations of mercury ranging from 25.8 to 71,200 mg/kg. Fourteen percent of the samples had either no detectable mercury, or were visually clean when samples were collected. In comparison, of the 12 exterior sewer line sample locations (in manholes), 6 were visually clean, and no samples were collected. Of the six samples collected from the exterior sewer line locations, only three had concentrations of mercury above the analytical detection limits (see The Earth Technology Corporation, 1992c for analytical results). No concentrations of mercury in the three samples exceeded the residential PRG of 23 mg/kg.

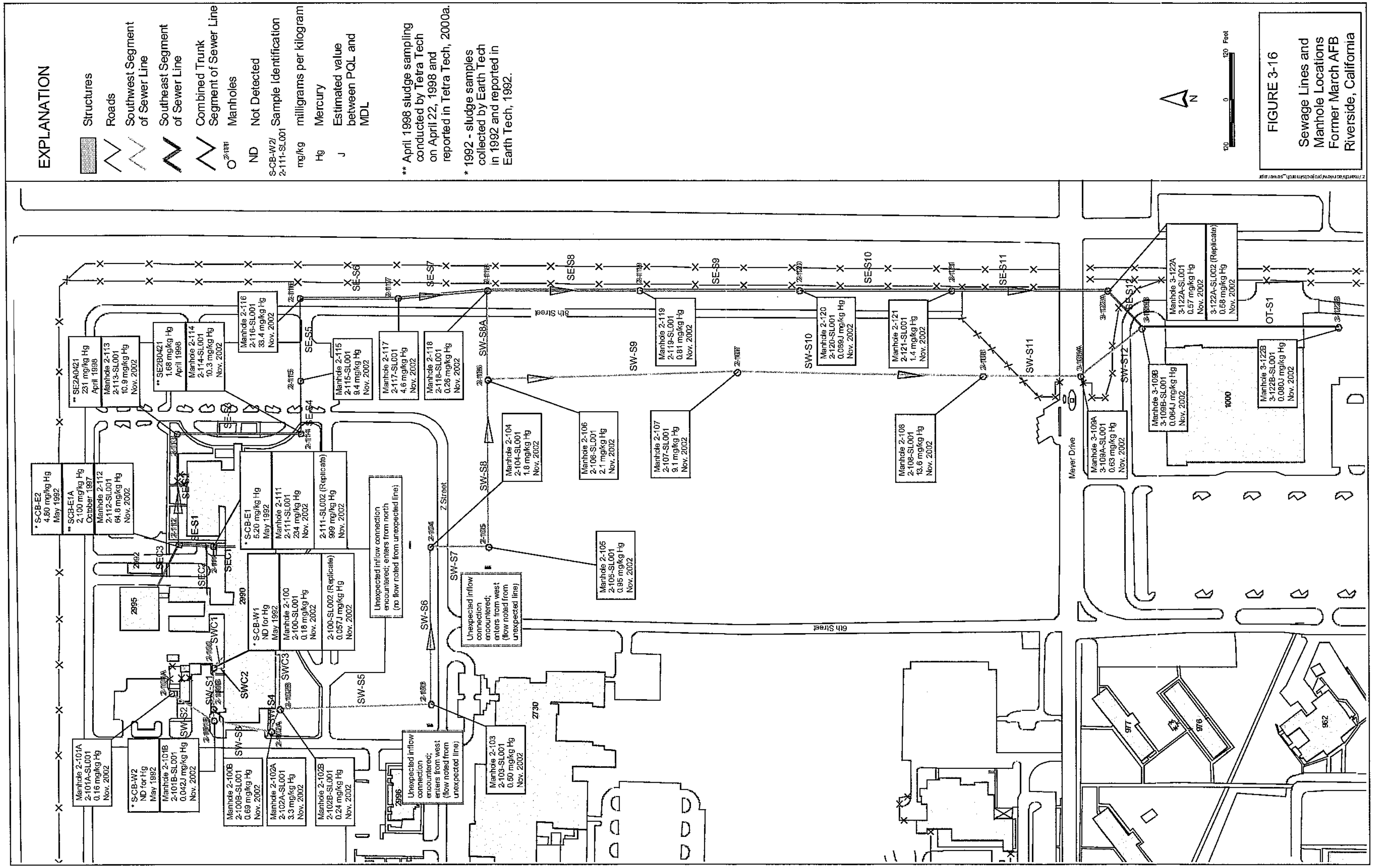
Previous video surveys were performed in 1992 on a portion of the two lines. Sewer line segments SE-S1, SE-S2, and SW-S3, approximately 72 feet, 286 feet, and 147 feet in length, respectively, were video logged (see Figure 3-16). Not all of the lines were accessible during that effort; those that were accessible were not always clean enough to allow a clear view of the inside walls and pipe joints.

Additional sampling conducted in 1997 to confirm the earlier findings at the site yielded different results (Tetra Tech, 2000a). Four internal samples were collected; all samples had concentrations of mercury reported above the detection limit. However, only two of these samples contained concentrations of mercury above the residential PRG (85 mg/kg and 110 mg/kg). One sample that was collected from the external sewer line had a concentration of 2,100 mg/kg. These results show significant differences between the findings of the initial study (The Earth Technology Corporation, 1992) and the more recent Tetra Tech investigation (Tetra Tech, 2000a). Neither of these sampling efforts collected data from the soil media outside of the two facilities or from around the sewer line.

Sampling of indoor air within the buildings was conducted in July 2000 with a Jerome Meter. Real time sampling and analyses of indoor air for mercury vapor showed no levels above the 1 microgram per cubic meter ($\mu g/m^3$) Jerome Meter detection limit (Tetra Tech, 2000b). Air samples collected from sinks and drains within the hospital yielded concentrations exceeding the detection limit (for sample results, refer to Tetra Tech, 2000b). These data suggest that health risks associated with the inhalation of indoor air are negligible, but a potential source (i.e., air in sinks) of mercury vapor may still exist. Moreover, the U.S. EPA Region IX PRG for mercury in ambient air is 0.31 $\mu g/m^3$. This PRG is approximately three-fold less than the Jerome Meter detection limit and well below the maximum concentration (63 $\mu g/m^3$) detected in air sampled from potential emission sources.

3.8.1.2 Previous Recommendations.

Previous recommendations were to evaluate the potential for a release to the environment through the leakage of mercury from the sewer pipe. The initial investigations also suggested that additional indoor air samples be collected to



EXPLANATION
Structures
Roads
Southwest Segment of Sewer Line
Southeast Segment of Sewer Line
Combined Trunk Segment of Sewer Line
Manholes
ND Not Detected
S-CB-W2/ 2-111-SL001 Sample Identification
mg/kg milligrams per kilogram
Hg Mercury
J Estimated value between PQL and MDL
** April 1998 sludge sampling conducted by Tetra Tech on April 22, 1998 and reported in Tetra Tech, 2000a.
* 1992 - sludge samples collected by Earth Tech in 1992 and reported in Earth Tech, 1992.
N
120 0 120 Feet
FIGURE 3-16
Sewage Lines and Manhole Locations
Former March AFB
Riverside, California
6th Street
Z Street
Meyer Drive
Manhole 2-101A 2-101A-SL001 0.16 mg/kg Hg Nov. 2002
* S-CB-W2 ND for Hg May 1992
Manhole 2-101B 2-101B-SL001 0.042J mg/kg Hg Nov. 2002
Manhole 2-100B 2-100B-SL001 0.69 mg/kg Hg Nov. 2002
Manhole 2-102A 2-102A-SL001 3.3 mg/kg Hg Nov. 2002
Manhole 2-102B 2-102B-SL001 0.24 mg/kg Hg Nov. 2002
Unexpected inflow connection encountered; enters from west (flow noted from unexpected line)
Manhole 2-103 2-103-SL001 0.60 mg/kg Hg Nov. 2002
* S-CB-W1 ND for Hg May 1992
Manhole 2-100 2-100-SL001 0.18 mg/kg Hg Nov. 2002
2-100-SL002 (Replicate) 0.057J mg/kg Hg Nov. 2002
Unexpected inflow connection encountered; enters from north (no flow noted from unexpected line)
Unexpected inflow connection encountered; enters from west (flow noted from unexpected line)
Manhole 2-105 2-105-SL001 0.95 mg/kg Hg Nov. 2002
* S-CB-E2 4.80 mg/kg Hg May 1992
** SCB-E1A 2,100 mg/kg Hg October 1997
Manhole 2-112 2-112-SL001 64.8 mg/kg Hg Nov. 2002
* S-CB-E1 5.20 mg/kg Hg May 1992
Manhole 2-111 2-111-SL001 234 mg/kg Hg Nov. 2002
2-111-SL002 (Replicate) 999 mg/kg Hg Nov. 2002
Manhole 2-104 2-104-SL001 1.8 mg/kg Hg Nov. 2002
Manhole 2-106 2-106-SL001 2.1 mg/kg Hg Nov. 2002
Manhole 2-107 2-107-SL001 3.1 mg/kg Hg Nov. 2002
Manhole 2-108 2-108-SL001 13.6 mg/kg Hg Nov. 2002
** SE2A0421 231 mg/kg Hg April 1998
Manhole 2-113 2-113-SL001 10.9 mg/kg Hg Nov. 2002
** SE2B0421 1.68 mg/kg Hg April 1998
Manhole 2-114 2-114-SL001 10.3 mg/kg Hg Nov. 2002
Manhole 2-116 2-116-SL001 33.4 mg/kg Hg Nov. 2002
Manhole 2-115 2-115-SL001 9.4 mg/kg Hg Nov. 2002
Manhole 2-117 2-117-SL001 4.6 mg/kg Hg Nov. 2002
Manhole 2-118 2-118-SL001 0.26 mg/kg Hg Nov. 2002
Manhole 2-119 2-119-SL001 0.81 mg/kg Hg Nov. 2002
Manhole 2-120 2-120-SL001 0.089J mg/kg Hg Nov. 2002
Manhole 2-121 2-121-SL001 1.4 mg/kg Hg Nov. 2002
Manhole 3-109A 3-109A-SL001 0.63 mg/kg Hg Nov. 2002
Manhole 3-109B 3-109B-SL001 0.064J mg/kg Hg Nov. 2002
Manhole 3-122A 3-122A-SL001 0.57 mg/kg Hg Nov. 2002
3-122A-SL002 (Replicate) 0.58 mg/kg Hg Nov. 2002
Manhole 3-122B 3-122B-SL001 0.080J mg/kg Hg Nov. 2002
SW-S1 SW-S2 SW-S3 SW-S4 SW-S5 SW-S6 SW-S7 SW-S8 SW-S8A SW-S9 SW-S10 SW-S11 SW-S12
SE-S1 SE-S2 SE-S3 SE-S4 SE-S5 SE-S6 SE-S7 SE-S8 SE-S9 SE-S10 SE-S11 SE-S12
SWC1 SWC2 SWC3 SEC1 SEC2 SEC3 OT-S1
2995 2992 2990 2730 2996 1000 977 976 962

determine if there was a potential risk to workers inside the hospital and dental clinic from mercury vapors.

3.8.2 OU4 RI Investigation

The OU4 investigation of the former base hospital and dental clinic followed the protocol established in the Letter Work Plan for Additional Characterization of the External Sewer Lines of the Main Hospital and Dental Clinic (Earth Tech, 2002). Sediment/sludge from all manholes leading away from the March Hospital and Dental Clinic were sampled to determine the extent of mercury contamination in the sewer line. At the furthest point along the sewer line, where mercury concentrations were below the residential PRG of 23 mg/kg, the investigation assumed that release to the environment would not be likely. Therefore a detailed investigation was not warranted beyond that point. For the area where mercury concentrations in the sediment/sludge within the sewer manholes exceeded residential PRGs, a video survey of the sewer line was made to identify broken, or separated pipe that may have allowed the release of mercury to the surrounding soil. Where these breaks were encountered, the plan was to collect subsurface soil samples adjacent to and beneath the sewer pipe to determine if mercury was present in soil at concentrations above the residential PRG of 23 mg/kg.

The second phase of the investigation focused on indoor air samples to determine if there was risk to potential future workers from mercury vapors emanating from floor and sink drains within the facilities.

3.8.2.1 OU4 Objectives.

The purpose of this investigation was to evaluate potential threats to human health posed by mercury within the sewer system of the Hospital and Dental Clinic within the context of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigation and building upon the results of earlier investigations. Two potential exposure pathways were considered: one through leakage from external, underground sewer lines, and the other through internal, ambient air. For the soil pathway, this project focused only on sewer lines outside the buildings to assess whether there were locations along these sewer lines that may have leaked into the surrounding soil. The two objectives for the sewer line were to (1) characterize the presence or absence of mercury within sludge found inside the sewer line, and (2) confirm the presence or absence of soil contaminated with mercury surrounding the pipe. Sludge material from inside the sewer line was sampled at manhole access points. Areas of potential leaks were identified in the sewer line using a video survey, and soil samples at suspect locations underlying the line were collected and analyzed for mercury. For the ambient air pathway, samples were collected within the two buildings. These samples supplemented earlier indoor air sampling and analysis results, which suggest that the threat from exposure to potential receptors via inhalation of ambient air was small.

3.8.2.2 Review of Field Activities.

The OU4 field investigation was carried out between November 2002 and March 2003. The field investigation was designed to evaluate the concentrations of mercury in the sludge within the sewer line, to detect any possible releases of mercury from the sewer line, and to assess the levels of mercury in the ambient air inside the hospital and dental clinic The investigation consisted of the following five field efforts at the Hospital and Dental Clinic:

- Sludge samples were collected in all manholes downstream of the Hospital/Dental Clinic to the manhole before the sewer line connects with the rest of the base to determine the extent of mercury contamination within the sewer line.
- After sludge samples were collected, a video survey was performed inside a section of the sewer line to determine if there were any areas of a potential release of contamination into the environment
- Subsurface soil samples were collected underneath the potential leak source.
- Air samples were collected for mercury vapor inside the Hospital and Dental Clinic
- IDW was generated during the video surveying and disposed of at an appropriately licensed facility.

3.8.2.3 Variations from the Work Plan.

The field work was performed in accordance with the approved letter work plan prepared by Earth Tech (2002). Sludge and sediment samples were collected from the manholes of the sewer main, the sewer main was video surveyed from the Hospital/Dental Clinic to a point along the main sewer line where mercury concentrations in the sediment/sludge was below the residential PRGs, subsurface soil samples were collected where the video survey showed potential breaks or separations in the sewer pipe that might represent a potential leak, and indoor air samples were collected within the hospital and dental clinic to evaluate potential inhalation hazards.

3.8.2.4 Summary of Laboratory Methods.

Sludge and sediment samples collected within each sewer manhole were analyzed for mercury using EPA Method SW7471A. Soil samples collected adjacent to and directly beneath the sewer pipe were analyzed for mercury using EPA Method SW7471A Ambient indoor air samples were analyzed using NIOSH Method 6009. Table 3-18 summarizes the number of samples collected during each phase of this investigation.

Table 3-18. Analytical Summary

Sample Type	Method	Number of Samples Collected	Method Detection Limit (MDL)	Number of Detects
Sludge Samples	SW7471A	27	0.1 mg/kg	27
Soil	SW7471	2	0.1 mg/kg	2
Ambient Air	NIOSH 6009	12	0.05 µg/m^3	12

mg/kg = milligrams per kilogram
µg/m^3 = micrograms per cubic meter

3.8.3 Physical Site Conditions

The base hospital and dental clinic are situated in the northeast corner of the former base near the intersection of Cactus Avenue and Heacock Street (off base). From the on base side the base hospital is bounded by North Avenue on the north, 5th Street on the west, 8th Street on the east, and Meyer Drive/Kennedy Boulevard on the south. It is located in the N ½ of the SE ¼, Section 13, Township 3 South, Range 4 West, of the San Bernardino Base Meridian, Sunnymeade 7 ½ Minute Quadrangle (USGS, 1967d).

3.8.3.1 Surface Features.

The surface topography around the former Hospital and Dental Clinic is relatively flat with a gentle slope to the south of 20 to 30 feet per mile. Major drainage features lie north and east of the site and consist of intermittent drainage channels (Cactus Channel Storm Drain and the Heacock Storm Drain). The hospital lies at an elevation of approximately 1,540 feet above MSL. There are no major drainages across the site, and there are no perennial water bodies near the site.

3.8.3.2 Stratigraphy.

Two hand auger boreholes were drilled to a maximum depth of 7 feet bgs. The boreholes were installed to collect soil samples directly beneath the sewer line at locations where there was a potential leak from the sewer line (cracked pipe or pipe separation) Soil was composed of silty sand. Boreholes were not drilled any deeper than 7 feet bgs. However, based on the OU1 and OU2 investigations, the stratigraphy at site is not expected to be different than other sites on the base (i.e., alternating layers of silty sand and sandy silt with occasional thin lenses of clean sand and clay).

3.8.3.3 Groundwater.

While groundwater was not part of this investigation, groundwater is reported to be 25 to 30 feet bgs in the area of the former Hospital. The groundwater flow direction is to the south and east in both the A and B hydrostratigraphic units (MWH, 2004)

3.8.4 Nature and Extent of Contamination

To assess the presence and location of mercury inside the sewer line, sludge samples were collected from each manhole beginning at the manholes immediately exterior to the Hospital and ending at manhole 3-122B The last manhole (3-122B) is the location where the Hospital sewer line comes together with the main trunk line (see Figure 3-17) Using access through the manhole opening, material was collected inside each manhole using a plastic sampling scoop (Bel-Art® Long-Handled Dipper) The amount of material present varied within each manhole, but there was enough material present to collect a representative sample from each manhole. Each sample was placed in a 500 milliliter (mL) glass jar and sent to a California licensed laboratory to be analyzed for mercury using USEPA Method SW 7471A

Twenty-seven sludge samples and three replicates were collected The three replicate samples were collected directly underneath their respective samples. There was no visible "free" mercury detected in the samples. The maximum concentration came from sample 2-111-SL002 (a replicate), which was 999 mg/kg. Four of the thirty samples exceeded the residential PRG of 23 mg/kg (see Table 3-19 and Appendix A for analytical results).

Based on the sludge sample analytical results, a video survey was conducted on the section of sewer line that contained mercury concentrations above PRG levels for residential soils. The videoed section started at manhole 2-111 on the southeast side of Building 2990 (including the lines identified as SEC 1, SEC 2, and SEC 3 that connect to the building) and continued through to manhole 2-116 (see Figure 3-16). The selected pipe section was cleaned in advance of the video camera to allow passage of the video equipment, and to enhance the visual inspection for potential leaks A vacuum truck was employed during the cleaning process to capture the liquid waste generated during the process. A plug was installed at the effluent end of manhole 2-116 to prevent the passage of wastewater to the lifting station The vacuum truck collected the wastewater from manhole 2-116 where the plug was installed. The wastewater was transferred to an on-site Baker tank once the cleaning process was complete. An Omni-Eye 3, tractor-mounted, high-resolution video camera with pan and tilt capability on a flexible lead was used to survey the sewer line section. A videotape of the camera inspection was provided along with an inspection report of the sewer lines surveyed This video survey identified only one location where a potential leak source was identified in sewer line segment SEC 3. A circumferential crack at a joint from 3 to 7 o'clock. The crack was 78.52 feet from manhole 2-112 towards the Dental Clinic (see Figure 3-16 for crack location and soil results).

Two subsurface soil samples and a replicate sample were collected directly underneath the section of the sewer line (SEC 3) where the crack was located. Because the samples were collected from soils directly underlying the sewer pipe, a 60-degree angled borehole was used to reach the desired sampling point without damaging the pipe. Since the depth to the bottom of the sewer line was estimated at 3 feet 5 inches bgs, a hand-held power auger was used to advance the auger hole more rapidly and easily than augering the entire depth by hand

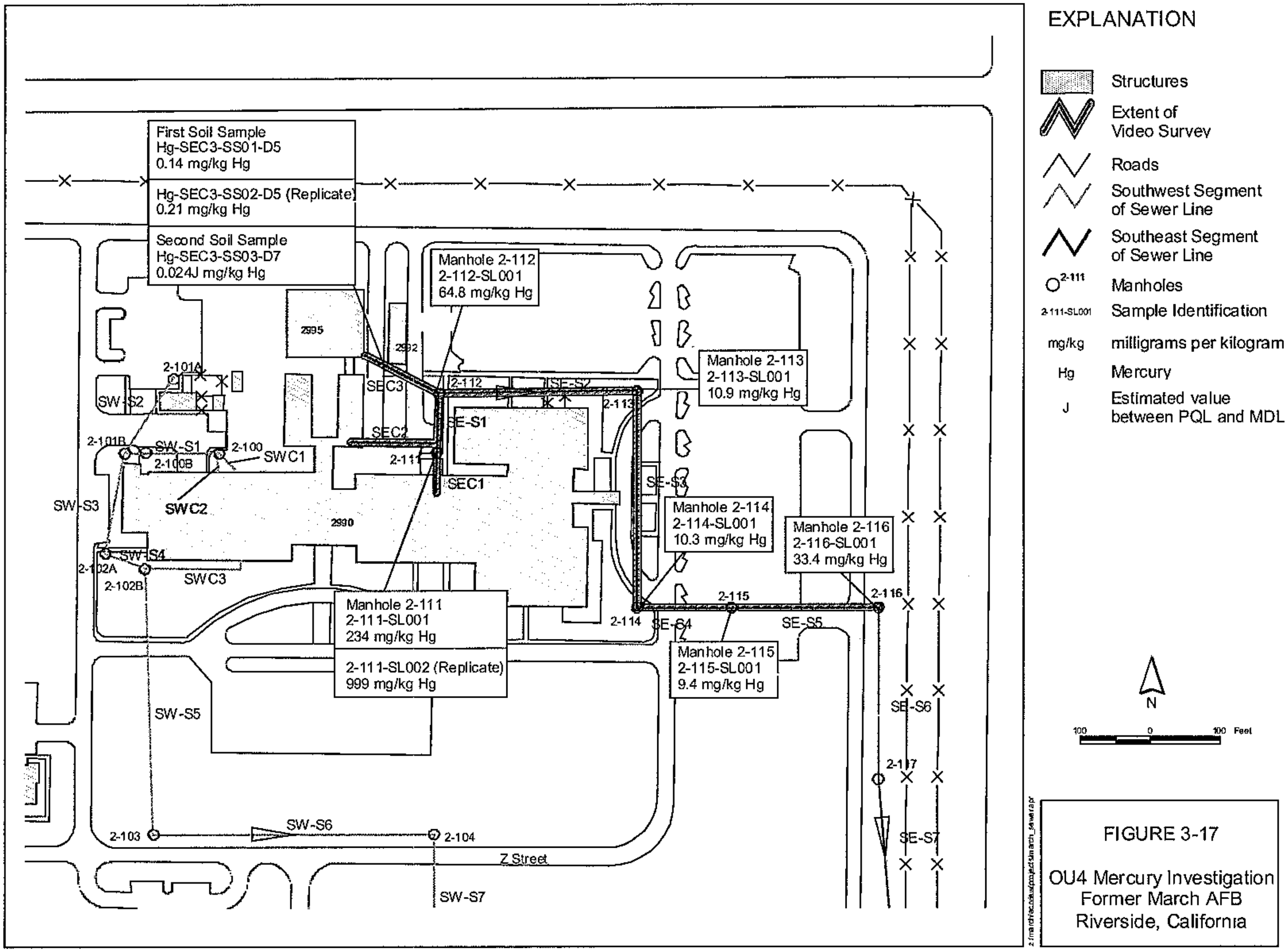
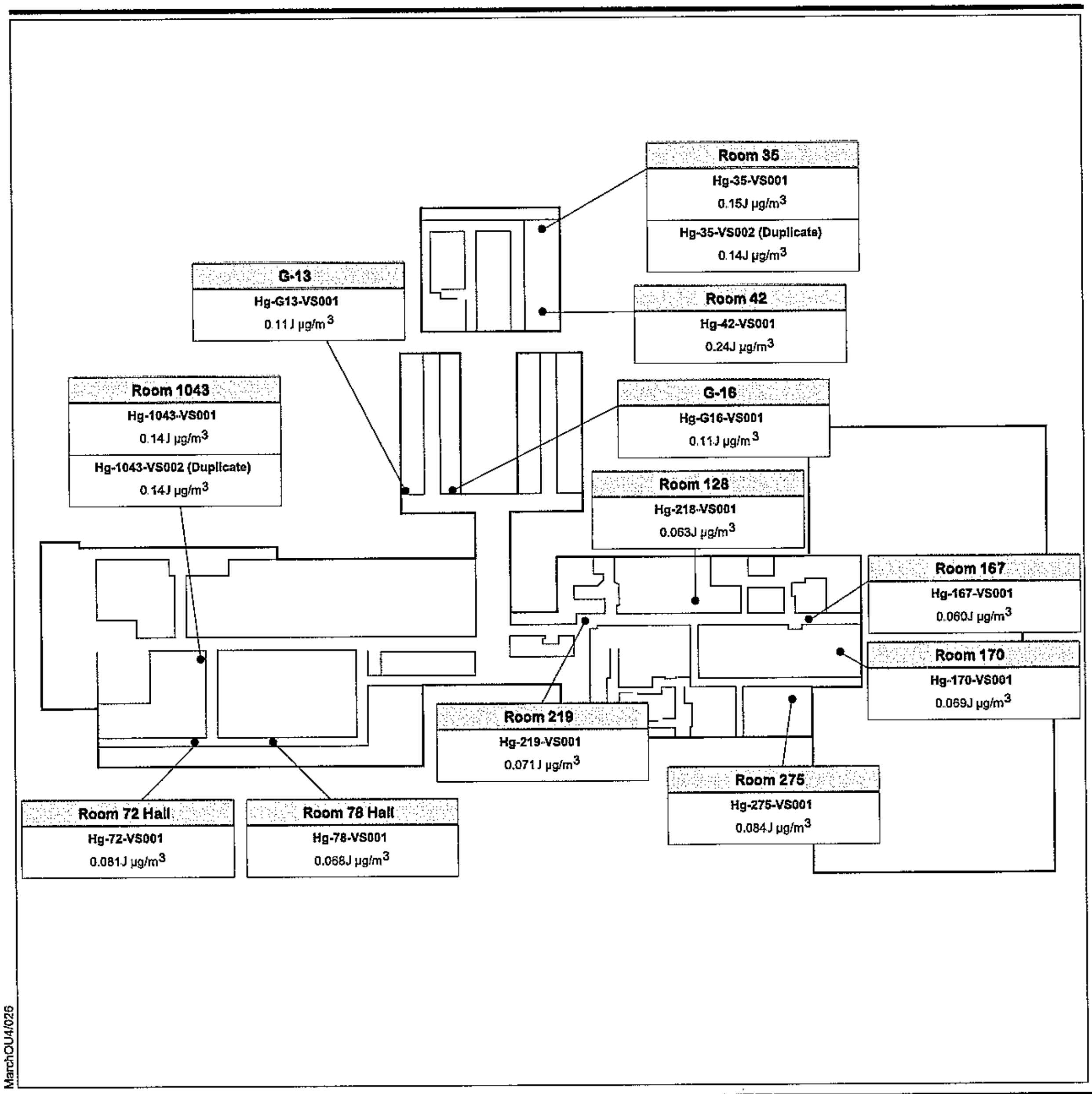


FIGURE 3-17

OU4 Mercury Investigation
Former March AFB
Riverside, California



EXPLANATION

- ● Location of air samples collected
- J Estimated value between the PQL and MDL
- $\mu g/m^3$ Micrograms per cubic meter

Air Sampling Locations and Results, Former March Hospital and Dental Clinic

Figure 3-18

Table 3-19. Sludge Analytical Results

Manhole	Results (mg/kg)
2-101B-SL001	0.042J
2-100-SL001	0.18
2-100-SL002 (Replicate)	0.057J
2-101A-SL001	0.16
2-102A-SL001	3.3
2-102B-SL001	0.24
2-100B-SL001	0.69
2-103-SL001	0.50
2-104-SL001	1.8
2-105-SL001	0.95
2-112-SL001	64.8
2-111-SL001	234
2-111-SL002 (Replicate)	999
2-113-SL001	10.9
2-114-SL001	10.3
2-115-SL001	9.4
2-116-SL001	33.4
2-117-SL001	4.6
2-118-SL001	0.26
2-106-SL001	2.1
2-119-SL001	0.81
2-107-SL001	9.1
2-120-SL001	0.089J
2-108-SL001	13.6
2-121-SL001	1.4
3-109A-SL001	0.63
3-122A-SL001	0.57
3-122A-SL002 (Replicate)	0.58
3-109B-SL001	0.064J
3-122B-SL001	0.080J

J = Estimated value between the Practical Quantitation Limit (PQL) and the Method Detection Limit (MDL) (see Appendix A for PQL and MDL values).

Power augering ceased when the hole was within a couple of feet of the desired sampling point and above the pipeline. The hand auger was then used to complete the hole. Samples were collected using an AMS slide-hammer sampler, which contained a clean stainless steel sleeve. The sampler was driven into the soil using the slide hammer. Once the sleeve was full, the drive sampler was removed from the auger hole, and the stainless steel sleeve was removed from the sampler. Teflon™ sheets and plastic end caps were placed over both ends of the stainless steel sleeve, using standard procedures. Utility clearance was performed prior to the use of the power and hand augers to ensure the safety of the field staff and the underground utility lines.

The first soil sample (Hg-SEC3-SS01-D5) and its replicate (Hg-SEC3-SS02-D5) were collected approximately 2 feet directly below the bottom of the sewer line (5 feet, 5 inches bgs) and the second soil sample (Hg-SEC3-SS03-D7) was collected approximately 4 feet directly below the sewer line (7 feet, 5 inches bgs) Table 3-20 is a summary of the analytical data for the three subsurface soil samples that were collected below the sewer line Appendix B provides the laboratory data sheets. All three sample results were well below the residential PRG for mercury in soil (23 mg/kg) with the highest concentration being 0.21 mg/kg.

Table 3-20. Subsurface Soil Sample Results

Sample ID	Results (mg/kg)
Hg-SEC3-SS01-D5	0.14
Hg-SEC3-SS02-D5	0.21
Hg-SEC3-SS03-D7	0.024J

J = Estimated value between the PQL and the MDL (see Appendix B for PQL and MDL values).

Twelve ambient air samples and two duplicates were taken to confirm previous results obtained in July 2000 by Tetra Tech (Tetra Tech, 2000b). Samples were placed in the same locations as previously collected by Tetra Tech Samples were collected using a Gilian® GilAir-5 Sampling Pump with a solid sorbent tube intake mounted in the breathing zone. The National Institute of Occupational Safety and Health Method 6009 was used to analyze the samples. The sampling pumps were run for a duration of 72 hours in order to obtain detection limits at the U S EPA Region IX residential PRG of 0.31 μg/m^3. Every sample was below the residential PRG of 0 31 μg/m^3. The maximum concentration was 0.24J μg/m^3 at sample Hg-42-VS001. Analytical results are summarized in Table 3-21.

Table 3-21. Indoor Air Sample Results

Sample ID	Results (μg/m^3)
Hg-35-VS001	0.15J
Hg-35-VS002 (Duplicate)	0.14J
Hg-42-VS001	0.24J
Hg-72-VS001	0.081J
Hg-78-VS001	0.068J
Hg-128-VS001	0.063J
Hg-167-VS001	0.060J
Hg-170-VS001	0.069J
Hg-219-VS001	0.071J
Hg-275-VS001	0.084J
Hg-1043-VS001	0.14J
Hg-1043-VS002 (Duplicate)	0.14J
Hg-G13-VS001	0.11J
Hg-G16-VS001	0.11J

J = Estimated value between the PQL and the MDL (see Appendix C for PQL and MDL values)

3.8.4.1 Soil Contamination.

Sludge Sampling Results. Twenty-seven sludge samples and three replicates were collected from each manhole leading from the Hospital and Dental Clinic to manhole 3-122B. Each sample looked visually clean. Mercury was detected in all 27 samples and 3 duplicates. Analytical results showed mercury was present in all samples and ranged from 0.042J mg/kg in manholes 2-101B to a maximum concentration of 999 mg/kg in a duplicate collected from manhole 2-111. Once the sludge sample results were received, they were used to define where the video survey was to be performed. The video survey was conducted only in the sections were the mercury contamination exceeded the residential PRG for soil (see Figures 3-15 and 3-16 Based on the analytical results, the video survey was performed from manhole 2-111 on the southeast side of Building 2990 (including SEC 1, SEC 2, and SEC 3 that connect to the building) and continued through to manhole 2-116 (see Figure 3-16). Refer to Table 3-21 and Appendix A for analytical results

Subsurface Soil Sampling Results. Based on a review of the video survey, a circumferential crack at a joint from 3 to 7 o'clock was identified in SEC 3. Two soil samples and one replicate were collected from below the circumferential crack in the sewer line. The first soil sample and its replicate were collected 2 feet below the bottom of the sewer line and the second soil sample was collected 4 feet below the bottom of the sewer line. All three samples had detectable levels of mercury ranging from 0.024J mg/kg to 0.21 mg/kg. Table 3-20 and Appendix B present the soil analytical results.

Indoor Air Sampling Results. Twelve ambient air samples and two duplicates were taken from inside the Hospital and Dental Clinic to confirm previous results obtained in July 2000 by Tetra Tech Each air sample was collected in the same location as previous air samples collected by Tetra Tech. A total of 12 ambient air samples and two duplicates were collected All air samples had detectable levels of mercury at concentrations ranging from 0.069J $\mu g/m^3$ to 0.24 $\mu g/m^3$. Analytical results are presented in Table 3-21. Figure 3-17 shows the locations where ambient samples were collected.

3.8.4.2 Groundwater Contamination.

The potential for groundwater contamination was not expected to be an issue at the site since free mercury is not very mobile. Therefore, groundwater was not investigated at the former Hospital and Dental Clinic as part of this task

3.8.4.3 Site Characterization Summary.

Mercury contamination was limited to low concentrations in soil adjacent to the sewer line, and low levels of mercury vapor are present in ambient air within the building. This is based on sludge/sediment samples taken from the sewer manholes, subsurface soil samples adjacent to the sewer line, and indoor ambient air samples collected in the former Hospital and Dental Clinic during the

OU4 investigation. Mercury concentrations within the sewer were high in some manholes; however, 1,100 feet downstream of the Hospital, the level of mercury in the sewer line was minimal, and the threat to human health and the environment was negligible. The video survey of the sewer line also showed that at least 1,100 feet downstream of the Hospital, the sewer line was in excellent condition and that the potential release of mercury from breaks in the sewer line was not identified.

3.8.5 Potential Migration Pathways

Concentrations of mercury in soil and ambient air are minimal and an evaluation of Potential Migration Pathways was not necessary.

3.8.6 Risk Assessment

A video inspection of the sewer line in the area most contaminated with residual mercury showed the line to be in excellent condition and there was no evidence of breaks or potential leaks from the sewer system near the former base hospital and dental clinic. Subsurface soil samples collected adjacent to and immediately below the single crack identified in the sewer line showed that mercury contamination was not present at concentrations above residential PRGs. The investigation concluded that the potential release of mercury to the environment was very low. Sampling of indoor ambient air at several locations within both the hospital and dental clinic also showed that mercury vapors in ambient air were also below residential PRGs. Therefore, the potential risk to human health and the environment due to mercury release at the former hospital/dental clinic is very minimal.

3.8.7 Conclusions

Based on analytical results from sludge and sediment samples collected within manholes leading from the Hospital and Dental Clinic, mercury contamination is present in the sewer system at levels above EPA Region IX PRGs up to 1,100 feet downstream of the Hospital (manhole 2-116). A video inspection of the sewer line showed that the sewer line was in excellent condition with the exception of one location. A small crack was observed in the sewer line between the Dental Clinic (Building 2995) and manhole 2-112. Subsurface soil samples collected immediately adjacent to the sewer pipe and directly below the observed crack showed that mercury was present but at concentrations well below EPA residential PRGs. Ambient air samples collected inside the buildings (Buildings 2990 and 2995) also showed detectable levels or mercury in the air samples but were also well below residential PRGs. Therefore, no unacceptable risk is associated with the Hospital or Dental Clinic, and no apparent release of mercury above residential PRGs was identified during this investigation.

3.8.8 Recommendations

Based on the results of sludge and soil samples collected from the manholes and soil immediately adjacent to the sewer line, mercury has not been released from the sewer main at concentrations that would pose an unacceptable risk to human health or the environment. In addition, ambient air samples collected inside the Hospital and Dental Clinic suggest that there is no hazard present for any future use of the building. Therefore, the site is recommended for NFA.

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